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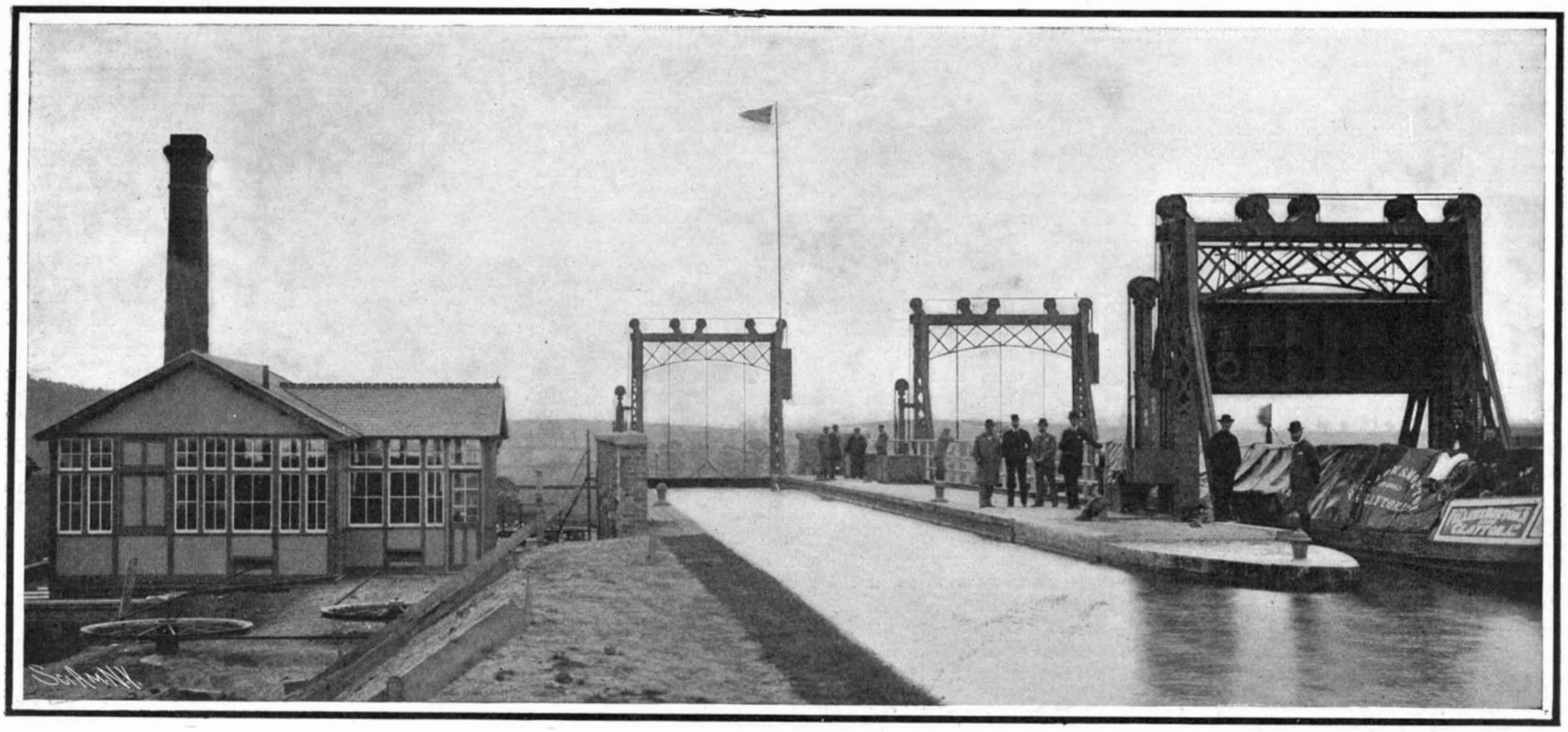
A NOVEL CANAL LIFT AT FOXTON.

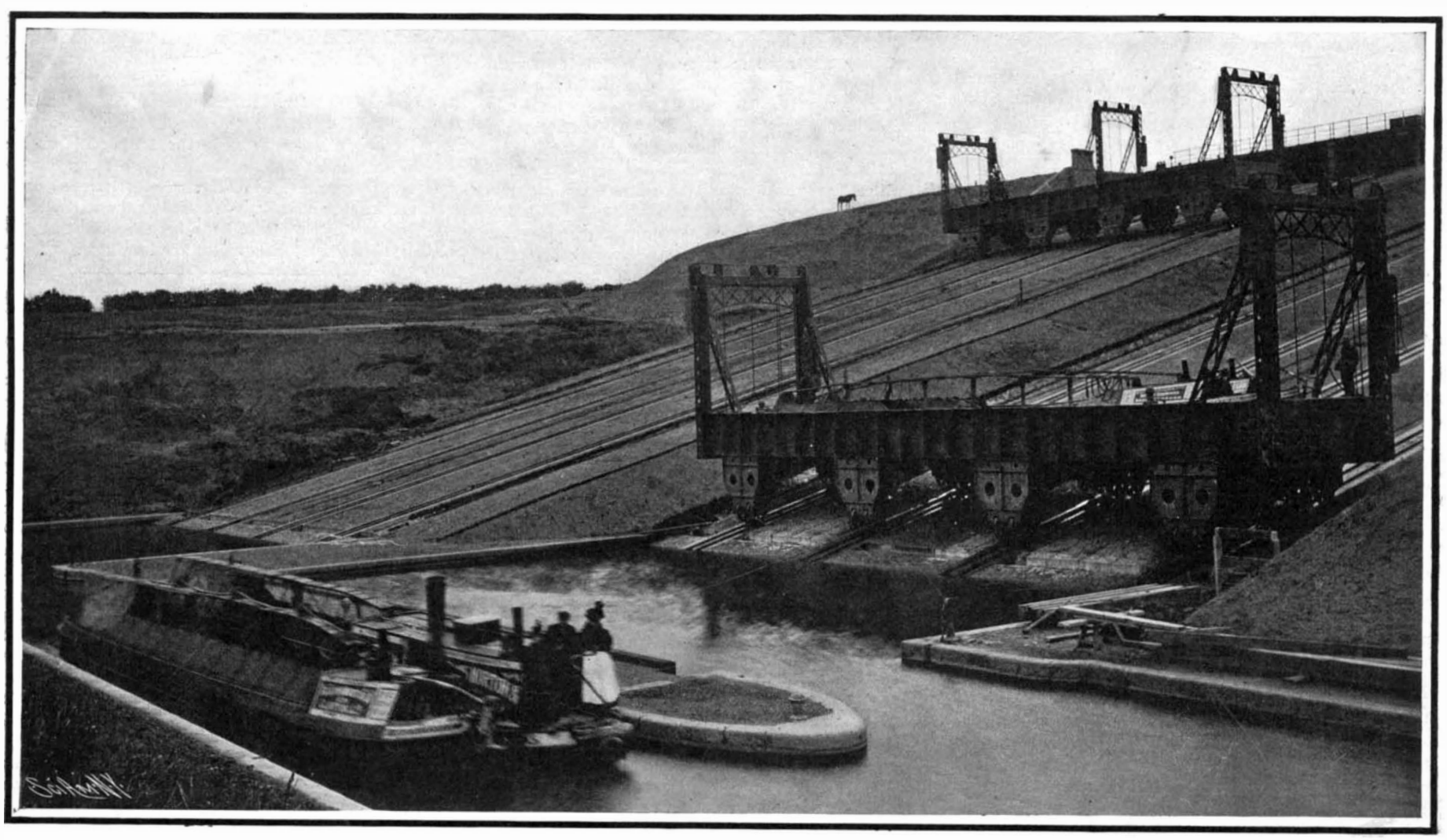
BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Although the transit of freight in bulk by canal is conceded to be the cheapest process of conveyance from one point to another, yet it has one great drawback. This salient disadvantage is the amount of time occupied in the completion of the journey. Quick dispatch is imperative in these commercial days of high pressure, and it is owing to the slowness of this system of transit, in comparison with railroad celerity, even in connection with freight trains, that the utilization of the waterway has fallen into such desuetude. The consequence is that the canals are only used in those instances where the peculiar nature of the goods, or no necessity for quick transit, renders it available. Attempts to accelerate canal conveyence and to render it sufficiently rapid to compete with freight trains are being made by the employment of electric traction in lieu of horse towing, although these efforts are to a certain extent handicapped by the

(*Continued on page 159.*)

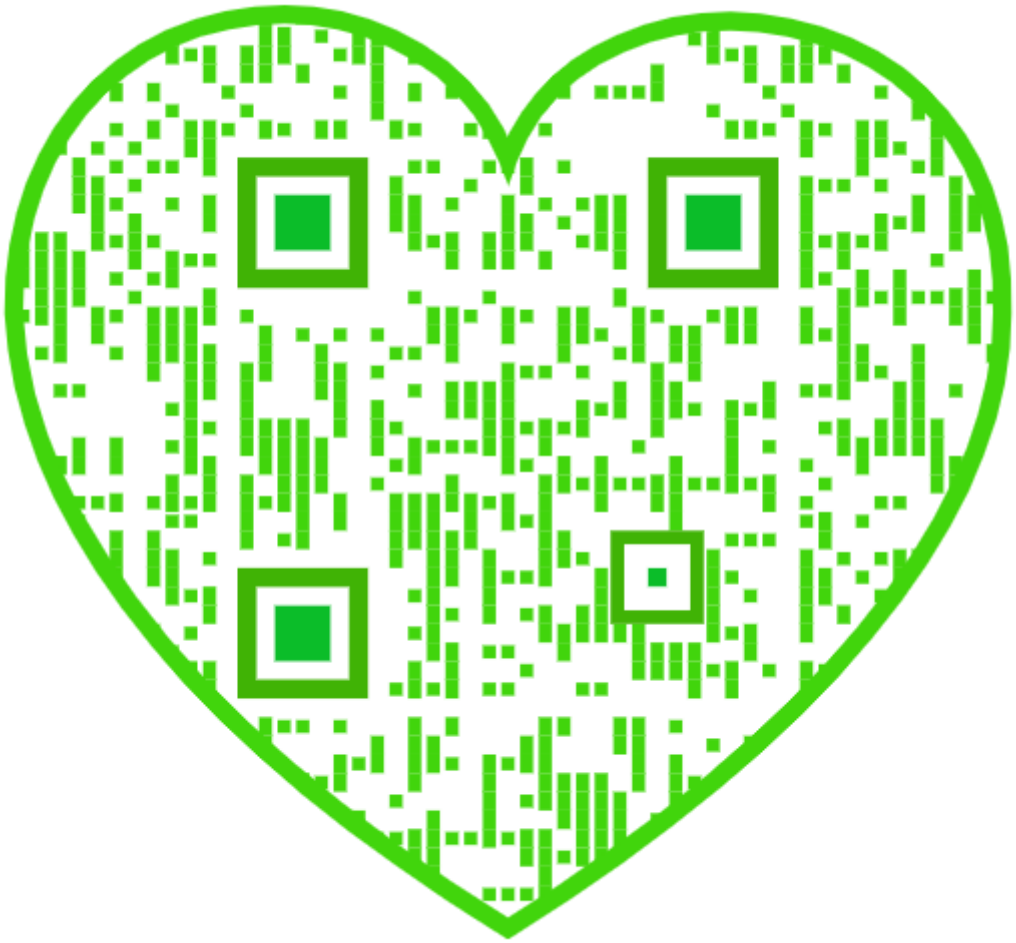


Top of the Lift, Showing Raised Barge Passing from Tank into Upper Reach of Canal. Power House and Guide Pulley on the Left.



The Barge Lift in Operation. Descending Tank Loaded. Height of Lift, 75 feet; Grade, 1 in 4.

A NOVEL CANAL LIFT AT FOXTON, ENGLAND.



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NEW YORK, SATURDAY, SEPTEMBER 3, 1904.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE MANHATTAN BRIDGE FIASCO.

In our issue of July 16 we presented a *résume* of the history of the city's abortive attempt to build a suspension bridge across the East River, at a point adjacent to the present Brooklyn Bridge; and we think that the average citizen of New York would have found that story positively entertaining, had it not been so completely humiliating to his civic pride. In the article in question, which is accompanied with illustrations of the substitute plans which are proposed by the present Bridge Commissioner, no attempt was made to criticize the engineering features of these plans, and this, not for the reason that they were by any means beyond criticism, but because we felt that the time was not then ripe for such discussion.

Judged purely from the æsthetic standpoint, the new design, if we except the anchorages, is pleasing, particularly as compared with the recently completed Williamsburg Bridge. The improvement is due to the very shallow depth of the stiffening truss, which runs at the floor level from end to end of the structure. Unfortunately for the design, what it gains in appearance from this shallow truss, it loses in structural efficiency. The object of such a truss is to prevent local sagging of the cables under a concentration of load at any point in the bridge where it may occur; but the ability of a truss to resist this bending is proportionate to its stiffness, and its stiffness is directly proportionate to the cube of its depth. Hence, other things being equal, the shallow truss, such as here proposed, will be a weak truss, unless, indeed, it be made extraordinarily heavy and an immense amount of steel material be massed into the upper and lower lines of the trusses, or what are technically known as the top and bottom chords. But if such a massing of material be made in order to compensate for weakness due to shallow depth, the truss becomes inordinately heavy, and an additional amount of material must be put into the steel cables to carry the increased weight of the trusses; consequently the bridge becomes proportionately heavy and costly.

Now this decreased strength and stiffness, or greatly increased weight and cost, as the case may be, does not appear in such a dainty little drawing of the bridge as was shown in our issue of July 16. It does not appear in the elaborately-shaded plans that were submitted to the Municipal Art Commission. All that is seen in those plans is a pretty picture of a rather graceful-looking structure. Such a drawing gives no information whatever as to the strength, the weight, the rigidity, the ease of erection, the cost of erection, and the thousand and one other items which must be carefully considered by the expert engineer before it can be said whether such a design is a practicable and useful one. It may be pretty—it is pretty. But before the city embarks on an expenditure of twenty million dollars for a public utility, it wants something more than a fanciful sketch, hastily drawn up by a newly-installed Bridge Commission.

Let us briefly state what are the indispensable requirements for the bridge in question. First, in view of the frightful conditions of congestion on the present Brooklyn Bridge, the new design should be of such a character as to admit of the most speedy erection. Secondly, in view of the astonishing rate at which travel between New York and Brooklyn increases, and the absolute certainty that big and wide as the bridge is being made, it will, before many generations have passed, be called upon to carry even more than its estimated load, it is imperative that the structure should be made exceptionally rigid and strong. Thirdly, it should have as great architectural or æsthetic beauty as is consistent with the requirements above stated. Now, comparing the two designs, the one accepted by the Municipal Art Commission was provided with eye-bar cables with a view to speedy erection, and it is certain that it can be constructed under contract in from three and a half to four years. It is equally certain that the new design with wire cables would take from one and a half to two years longer to construct, for the new Williamsburg Bridge, built generally upon the same lines and with wire cables, consumed over seven years in construction. As regards the comparative rigidity, the design accepted by the Municipal Art Commission embodies stiffening trusses that have a maximum height of 58 feet, whereas the new design gains its architectural appearance by cutting down this height from 58 to 24 feet, which is 16 feet less than the height of the trusses in the existing Williamsburg Bridge. We venture to say there is not a single competent bridge engineer in the world who, when first looking at this design, did not feel astonished to see that the designers should have returned, in a bridge of this stupendous magnitude, to principles of construction in the way of shallow stiffening trusses that were condemned and abandoned forty years ago. This very element of shallowness in the trusses condemns the design from an engineering point of view at the very first glance.

There is one more point of comparison of the two bridges which is perhaps the most important of all, and that is that whereas the design accepted by the Municipal Art Commission, prior to its acceptance, was submitted by the Mayor to the most eminent board of bridge experts that could be gotten together in this country, and was cordially indorsed by them, the new design, which was drawn up by one of the subordinates of the engineer who designed the first bridge, has never been submitted to any board of experts, and therefore has nothing back of it, in an engineering sense, more than the individual opinion of the engineer and his associates. The Municipal Art Commission can pass upon the æsthetic elements of the new design; but until this design has been submitted to an expert board, the Art Commission finds itself at a great disadvantage in making any comparison of the comparative engineering value of the two designs. For reasons best known to himself, the present commissioner appears unwilling to have any expert commissioner pass upon his plans; although if those plans are in complete shape it would not take more than a month's time to secure a report upon them. Why is the present bridge commissioner unwilling to submit these plans to the same expert investigation which passed upon the plans that he had rejected?

PERILS OF THE SUBMARINE.

The narrow escape of the crew of the submarine torpedo boat "Porpoise" from a terrible death during some recent practice off Breton's Reef, again brings forcibly to mind the great perils which attend submarine work. As far as can be learned it seems that the "Porpoise," in charge of two lieutenants and eight men, took a position off the lightship and there submerged, intending to make a run at the depth of 20 feet. The type of submarine to which the "Porpoise" belongs accomplishes its diving by maintaining a slight reserve of buoyancy, and then setting the submerging rudders so that they carry the boat beneath the water, the depth of submersion being determined by the angle at which the rudders are set. It seems that, in the present case, the rudders became jammed, so that they continued to carry the vessel down until she rested on the bottom at a depth, according to press reports, of 120 feet. To raise the vessel, an attempt was made to blow out the water-tanks; but of course, at this great depth, the water pressure tending to crush in the "Porpoise" was considerably greater than that which she was designed to stand, amounting to 52 pounds to the square inch, or about 3¾ tons to the square foot. It seems that when the valves of the trimming tanks were opened in the endeavor to expel the water from the tanks, it was found that they would not operate. Moreover, the enormous crushing pressure upon the boat started leaks, and the water began to come in through the seams of the plating and around the joints of the torpedo tube. In this emergency, which was about as terrible as could be imagined, Lieut. Nelson, who was in charge, utilized an air pump worked by hand, to expel the water, and after a long period of hard work on the part of the crew the boat slowly rose to the surface and was towed into Newport.

It is supposed that the trouble was due to the fact that the boat had not been overhauled for cleaning for nearly twelve months, and that, consequently, the sea cocks had become choked. The terrible plight in which the crew found themselves brings to mind the recent accident in the British fleet when a submarine was run down and lost with its entire crew. If the accident proves to have been due to negligence in the upkeep of the boat, of course there will be nothing in the incident to shake the faith of those who believe in the submarine as such. On the other hand, the incident serves to illustrate the special perils that attend this form of naval service, unless it be conducted with extreme caution and unremitting watchfulness.

ELECTRIC POWER FOR OIL WELLS.

M. L. Gaster, a prominent German engineer, has recently brought out some facts regarding the use of electricity in connection with petroleum production. The world's petroleum production for 1903 stands at 20,000,000 tons, and of this more than one-half is furnished by Russia, the rest coming from the United States and Canada, Roumania, and Borneo. The demand for petroleum greatly exceeds the present production. The substitution of oil for coal, in order to be advantageous, needs a better regulation of the methods of producing it and also of the price. In this connection the use of electric motors is a question of great interest. One point of superiority is the suppression of fire risks. As concerns the industrial applications, it will be remarked that in Russia oil is cheaper than coal, so that all the vessels of the Caspian Sea and Volga, as well as the locomotives of the Caucasus between Baku and Batoum, are now burning oil in preference. In England and France the question is not so far advanced and is only in the experimental stage both as regards locomotives and stationary engines. The use of current, which is generated in a large central station to operate motors for petroleum wells, is justified by the great extent of ground covered by the wells, as well as the danger from fire caused by the steam engines which operate the drills and pumps. Another reason for using such a system is the variations of load which occur at the different wells. These three points alone will therefore explain the advantages of a central station system.

The first wells to be drilled by electric motors were in Roumania, where the system was inaugurated five or six years ago. The first installation, provided with a set of motor-driven pumps, was put in by the Dutel Company. A central station was erected at a distance of 1½ miles, to supply the current. The motors are of the three-phase type, operating at 300 volts. The total capacity of the station is 200 kilowatts. Later on, the Lahmeyer Company, one of the leading German electrical firms, erected a large station for the Roumanian company Steana Romana to be used in operating a great number of wells. Hydraulic power is used here and the turbine plant can furnish 1,500 horse-power. Four dynamos of the three-phase type were installed, giving 300 volts each. A set of transformers raises the voltage to 11,000 for a high-tension line which runs for 20 miles or more to the well-district. Near the wells is a reserve station which can run in connection with the central plant. It uses three Diesel motors of 300 horse-power each. The motors use crude oil and consume 0.28 liters per horse-power-hour. A year ago there were as many as 30 electric motors in use at the wells at Campana and 27 at Bushtenari, or about 60 in all. The first cost of the plant was $2,400 per well, and the running expenses $40 per horse-power-year.

In Russia the conditions are less favorable for the use of electric power. This lies in the fact that the oil which is now consumed to furnish the power for the wells, is not subject to any tax, and therefore a very cheap supply of energy can be had, although it is wasteful and accompanied by fire risks. However, it is to be noted that there are a number of electric plants for operating the wells in the Russian district. One of these is at Balachani and it was the first to be installed. Almost at the same time a second electric station was erected in the district belonging to the Nobel Company. In the spring of 1901 a large central plant was laid out for 1,500 horse-power to supply the wells belonging to the Apcheron Company, on the Caspian. The station uses two steam engines and two dynamos of the Allgemeine (German) make. A great number of motors are used at the wells. Since then other electric plants have been installed at Balachani, Bibi-Eybat, Baku, and other localities.

THE PRODUCTION OF IRON ORES IN 1903.

Again the United States has surpassed all competitors in its yearly output of iron ores. This is the most important fact contained in the report made by Mr. John Birkinbine to the United States Geological Survey on the Production of Iron Ores in 1903. The report, which will be part of the annual volume "Mineral Resources, 1903," has just been published as a separate pamphlet and may be obtained free of charge from the Director of the Survey. Its opening paragraph declares that the quantity of iron ore produced in the United States in the year ending December 31, 1903, was 35,019,308 long tons. This means a decrease of 534,827 long tons, or about 1½ per cent, from the maximum of 35,554,135 long tons in 1902. The quantity mined in 1903 is, however, the second largest recorded and is greater than the combined totals for the year 1902 of Germany, Luxemburg, and the British Empire, which are the nearest competitors of the United States. The data for 1903 for these countries are not yet available, but the same comparison will probably prove true for this year also.

The iron ore obtained in 1903 came from 22 States and 2 Territories. Minnesota, Michigan, Alabama, and Wisconsin were the leaders in production. Nevada was added this year to the list of producing States, while Vermont and Montana reported no ore mined in 1903.

The iron ore mined was of the four general commer-

cial classes: red hematite, brown hematite, magnetite, and carbonate. In 1903 the quantity of red hematite mined in the United States was 86.6 per cent of the total for the country, and of that Minnesota contributed over one-half. Alabama was the most important contributor of brown hematite. The three principal States that mined magnetite in 1903 were New Jersey, New York, and Pennsylvania. The red hematite showed a decrease of about 1 per cent from the production of 1902, the brown hematite and the magnetite a decrease each of 7 per cent. Only the carbonate ores, the least important class, showed an increase over the output of 1902. That increase amounted to no less than 26 per cent. As in 1902, all of this class of ore was obtained in Ohio and Maryland.

The Lake Superior district stands pre-eminent as a producer of iron ore. Its annual output exceeds that of any foreign country, and the average character of its ore is excellent. In the year 1903 the Mesabi and Vermilion ranges in Minnesota, the Marquette range in Michigan, and the Menominee and Gogebic ranges in Michigan and Wisconsin produced a total of 26,573,271 long tons of iron ore. Of this ore the Mesabi range alone produced 51 per cent. In addition to the above-named ranges in the United States, a sixth, the Michipicoten range, was opened in Canada in the year 1900, but its product in 1903, 223,976 long tons, is not included in the above data.

Of special interest in connection with the production of Wisconsin is the fact that the year 1903 witnessed the initial output of iron ore in the new Baraboo iron range, near the town of Freedom, in the southern part of the State. These deposits of Bessemer ore, which are within convenient railroad haul of the blast furnaces at Chicago, Ill., may furnish important additions to the ore supply of these furnaces.

The State of Pennsylvania showed a decline of 22 per cent from the total of 1902. This decline is due almost entirely to the diminished output of one of the large mines, the Cornwall Ore Hills, to which Pennsylvania has been mainly indebted for its position as a prominent producer of iron ores. New Jersey, on the other hand, showed an increase of nearly 10 per cent over its 1902 production. The construction of several modern furnaces was the chief cause of the increased output in New Jersey, and it is probable that an augmented production may be expected in the near future.

The total value at the mines of the 35,019,308 long tons of iron ore produced in the United States in the year 1903 was $66,328,415, or $1.89 a ton, an increase of 5 cents a ton, or 3 per cent, over the value per ton in 1902, viz., $1.84. In 1903 the highest average value at the mine was placed on the Colorado iron ores, viz., $3.12 a ton, and the lowest on Texas ores, $1 a ton.

Iron ore to the amount of 980,440 long tons, valued at $2,261,008, or $2.31 a ton, was imported into this country in 1903 from Cuba, Canada, Spain, Newfoundland, Algeria, the United Kingdom, British Columbia, Belgium, and Germany. It is evident from the relatively high value placed on the ores from some countries that the estimate is based on some other constituent than the iron contained in the ore. The total export of iron ore in the year 1903 was 80,611 tons, valued at $255,728. The greater portion of this went to blast furnaces located in the Province of Ontario, Canada.

THE HEAVENS IN SEPTEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

The principal item of astronomical news for the past month comes from the Harvard Observatory. It may be remembered that in 1899 the announcement was made that a faint satellite of Saturn had been discovered upon photographs taken at the Harvard station at Arequipa, Peru. So long a time has passed since then that astronomers were beginning to fear that the satellite had been "lost," because it had not been possible to obtain enough observations to determine its orbit. But a short note from Harvard, which appeared a few weeks ago, sets these doubts at rest.

The satellite has been photographed on many occasions in the last five years, and a long series of observations obtained this spring has made it possible to calculate the orbit, and predict the satellite's motion accurately. The details of this are to be published in the "Harvard Annals," but have not yet reached us.

The following facts have, however, already been published: The period of the satellite is about a year and a half and its distance from Saturn is nearly 8,000,000 miles. It is an exceedingly faint object, its magnitude being about 15½, and it requires a telescope of two feet aperture to see it at all—though it can be better observed photographically. Judging by its brightness, its actual diameter is about 200 miles.

This satellite, the faintest known in the solar system, has been named Phoebe by its discoverer, Prof. W. H. Pickering. Phoebe was a sister of Saturn, and as three of his other sisters, Rhea, Deone, and Tethys, as well as two brothers, Hyperion and Iapetus, are already commemorated among his satellites, she will find herself in good company.

In addition to its extreme faintness, the new satellite is remarkable for its very long period—six times as long as that of any other satellite in the solar system. The calculation of the changes produced in its orbit by the Sun's attraction will furnish a problem of great intricacy, which will keep the theoretical astronomers busy, while to secure accurate observations of so faint an object will demand great technical skill.

The astronomers of the Harvard Observatory are greatly to be congratulated upon this very interesting discovery—especially Prof. W. H. Pickering, who discovered the satellite by a comparison of photographs, and Dr. Stewart, who took the plates at Arequipa.

The European delegates to the Astronomical Conference at the St. Louis Exposition are now in America. The English delegate, Prof. Turner, of Oxford—the present president of the Royal Astronomical Society—has visited America several times, and requires no introduction; but the name of his colleague, Prof. Kapteyn, of the University of Groningen, in Holland, may be less familiar.

He is probably unique among astronomers in being the director, not of an observatory, but of a laboratory—an institution whose business is not the making of observations, but the working up of observations made by other people.

With a modern photographic telescope, it is possible to take so many plates in one night that weeks are required for their measurement and reduction. Very few such instruments can therefore be worked to anything like their full power, simply because few, if any, observatories have a large enough staff to handle the enormous amount of material that would be obtained.

Prof. Kapteyn, who had no large telescope at his disposal, conceived the idea of working in co-operation with some one who had one, and entered into an arrangement with Sir David Gill, by which a great number of plates taken at the Cape of Good Hope were forwarded to Holland for discussion. The result of twelve years' work appears in the three bulky volumes of the "Cape Photographic Durchmusterung," containing a catalogue of the places of more than 450,000 stars in the southern sky.

Since the completion of this great work, there have appeared a series of the "Publications of the Astronomical Laboratory of Groningen," some of which deal with the parallaxes of stars and clusters determined from measures of plates taken at other observatories, and forwarded to Groningen for reduction, while others, treating of mere general topics, such as the average distance of stars of a given magnitude, or the relative numbers of stars of different degrees of actual brightness, are perhaps the most important contributions that have been recently made to our knowledge of the sidereal universe.

All this work is of the highest scientific value, and the fact that it has been done with relatively very inexpensive apparatus points a useful moral.

There is no way in which an American amateur astronomer, or a professor in a small college, could do more useful astronomical work than by following Prof. Kapteyn's example, and working up photographs in co-operation with some great observatory.

A good deal of work of this kind has been done at Columbia University, as its long list of publications dealing with the Rutherford photographs testifies; and recently this work has been taken up at some other observatories—for example, at Vassar—but there is still plenty of room for more workers.

This sort of work is admirably fitted for the smaller colleges. A measuring machine of the highest accuracy costs only a few hundred dollars, and if used in co-operation with one of the great observatories, work of the highest quality could be done with a relatively small outlay. There is no doubt that photographs would be available for any one who knew how to use them.

This would be particularly good work for students, as its educational value is great, and it can be done at the student's own time, involving no night work, and being independent of the weather.

It is much to be hoped that a number of "astronomical laboratories" may soon be founded in the United States.

THE HEAVENS.

The brightest constellations now in sight lie in or near the Milky Way. Cygnus is directly overhead at nine o'clock in the evening in the middle of September, and Lyra is west of it. Aquila is south of Cygnus, just past the meridian, and Sagittarius is below it on the right.

Capricornus is due south. It contains no bright stars, but at present it includes Saturn, which is the brightest object in the southern sky. Aquarius and Pisces, which lie in the southeast, contain no bright stars, but Fomalhaut, which is south of them, in the constellation of the Southern Fish, is fairly conspicuous.

Pegasus lies above these, with Andromeda and Perseus on the left, and Aries below the two. Cassiopeia and Cepheus are in the Milky Way, between Perseus and Cygnus, and Auriga is rising in the northeast.

Boötes is low in the west, beginning to set. Corona and Hercules lie between it and Lyra. Ophiuchus and Serpeus fill the southwestern sky. Ursa Major is low in the northwest, with Draco and Ursa Minor above it.

THE PLANETS.

Mercury is evening star until the 15th, when he passes through inferior conjunction and becomes a morning star. He is invisible to the naked eye except for the last week of the month, when he rises about an hour before the Sun.

Venus is evening star in Virgo, setting about an hour after sunset. On the 23d she is quite near the bright star Spica.

Mars is morning star in Cancer and Leo, and is slowly moving out to the westward of the sun. He rises between 4.30 and 5 A. M. On the 28th he passes within a degree of the bright star Regulus.

Jupiter is on the borders of Pisces and Aries, and rises at about 8 P. M. in the middle of the month. His satellites afford a very interesting study for a telescope of three inches aperture or larger. On the evening of the 24th there is a specially interesting display, as the third and second satellites are successively eclipsed, and a little later the first satellite and its shadow cross the disk of the planet.

Saturn is evening star in Capricornus, southing at 10.30 P. M. on the 1st and at 8.30 on the 30th, and is well placed for evening observation.

Uranus is evening star in Sagittarius. On the 19th he is in quadrature, and comes to the meridian at 6 P. M.

Neptune is morning star in Gemini, and is observable before sunrise.

THE MOON.

Last quarter occurs at 10 P. M. on the 2d, new moon at 3 P. M. on the 9th, first quarter at 10 A. M. on the 16th, and full moon at 1 P. M. on the 24th. The moon is nearest us on the 9th, and farthest away on the 23d.

She is in conjunction with Neptune on the 4th, Mars on the 7th, Mercury and Venus on the 10th, Uranus on the 16th, Saturn on the 20th, and Jupiter on the 26th.

On the 9th of September there is a total eclipse of the sun. It is a remarkably long one—the duration of totality reaching six minutes—but, unfortunately, the track of the shadow, though 9,000 miles long by over 100 miles wide, lies entirely in the Pacific Ocean, without encountering any land at all, except at the extreme end. The eclipse can therefore only be observed on board ship, which precludes the use of telescopes and makes it improbable that any observations of much scientific value will be obtained.

Cambridge Observatory, England.

SCIENCE NOTES.

The relations between transparency, color, and temperature of the water are discussed by O. d'Aufsess in Ann. d. Physik.; the color affects the temperature, the temperature does not affect the color. It is not necessary to make comparative transparency observations always under the same conditions of the sky; the author found with his white disk, 1 meter in diameter, the same transparency value at noon with a cloudless sky, and after sunset. To study the influence of organic compounds which turn the color into yellow, he filtered water through vegetable earth, and determined the amount of soluble organic matter in the lake water.

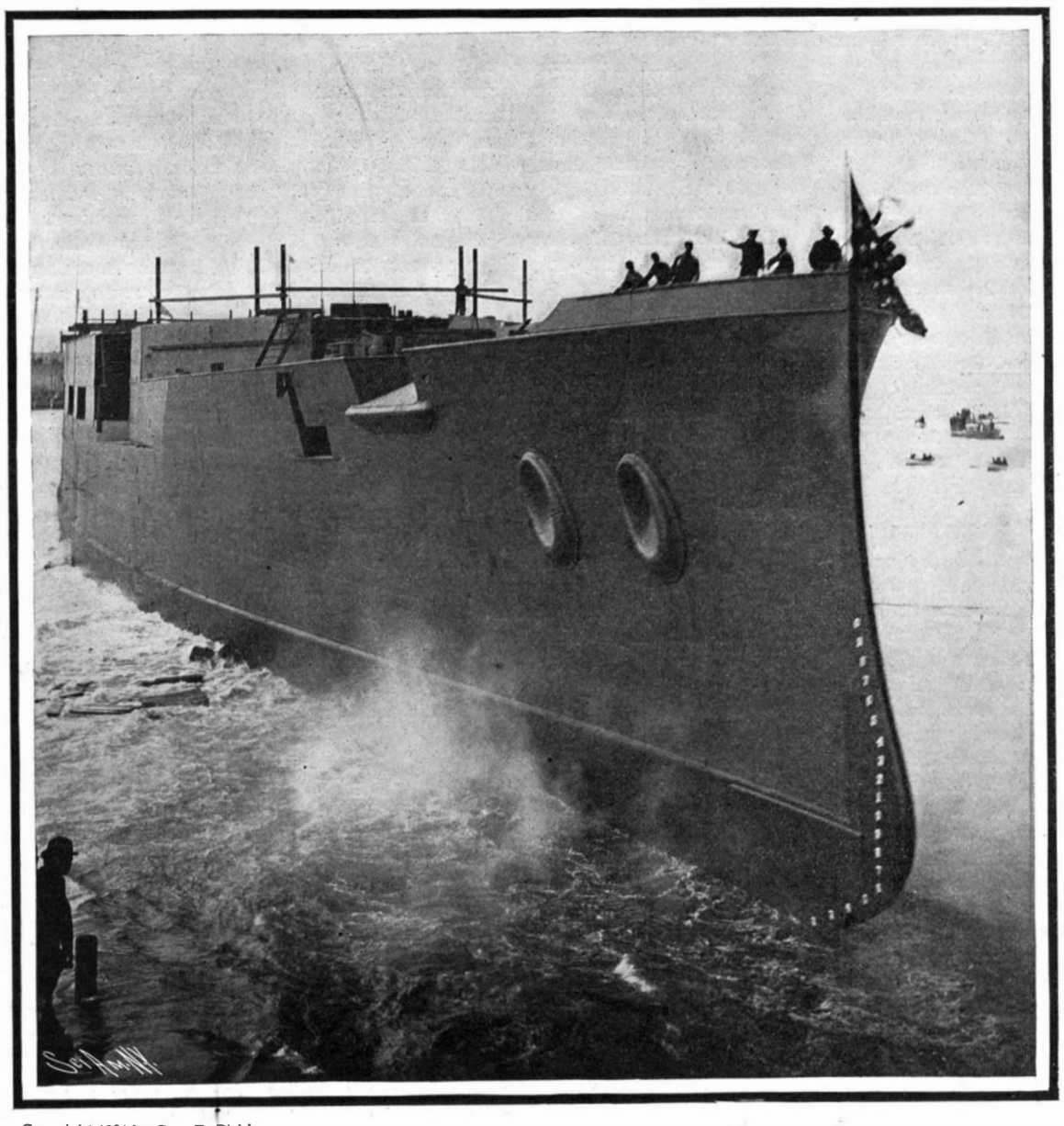
For the meteorological service in German East Africa H. Maurer has devised a sun-dial which has proved useful at twenty stations whose magnetic declination is unknown and whose latitude is only known within half a degree. The instrument is disk-shaped. The dial forms a semi-cylindrical surface, the axis of the cylinder, the style, lying in the plane of the framing. When the style is mounted parallel to the earth's axis, a plummet rests against the quadrant plane and marks the latitude on it. There is a notch in the style, producing on the dial a spot of light, whose position is, by turning the instrument, adjusted to the sun's declination for the day according to a table.

At the International Hydrographical conference recently held at Copenhagen, the Scottish delegate, Mr. Robertson, of Dundee, described some recent and interesting new discoveries he had made concerning the Gulf Stream. It has heretofore been popularly believed that the section of the Gulf Stream which reaches the Faroe Islands goes direct to Norway. Mr. Robertson has discovered from the result of his investigations that the section, however, travels first to the Shetland Islands and then to Norway. He also pointed out that the Southern Gulf Stream sends a section to the North Sea which runs along the coast of Scotland and the North of England, touches Jutland, and then travels north. The high degree of saltness and the temperature in the North Sea this hydrographer has found to be purely attributable to this source.

LAUNCH OF THE ARMORED CRUISER "SOUTH DAKOTA."

As the present war in the East progresses, and the reports of the various naval engagements come to hand, it becomes increasingly evident that the superior fighting value of the armored over the protected cruiser is being firmly established. It is battleship against battleship, armored cruiser against armored cruiser, and protected vessels against ships of the same class. Thus in the recent engagement in the Korean Strait, it was the four armored ships of the "Iwate" class that engaged the great armored cruisers of the "Rurik" class, and it was not until one of them, the "Rurik," was in a sinking condition, and her consorts had drawn off in the endeavor to escape, that a couple of cruisers dared to venture in and deliver the final blows.

The value of the armored cruiser being thus so thoroughly established, it is fortunate that for several years past the United States navy has built all its cruisers of the armored type. At present we have six vessels of this class under construction, which are among the largest and most powerful afloat—the "Colorado" and the "Pennsylvania," building by William Cramp & Sons, Philadelphia; the "Maryland" and "West Virginia," building at Newport News, and the "California" and "South Dakota," which are under construction at the Union Iron Works, San Francisco. The last of these vessels to be launched was the "South Dakota," which forms the subject of the accompanying illustration. The six vessels are identical, and the following description of the "South Dakota" will answer for any one of the class.



Copyright 1904 by Geo. P. Pitkin.

Displacement, 13,680 tons. **Speed,** 22 knots. **Coal supply,** 2,000 tons. **Armor:** Waterline belt, 6 inches; turrets, 6½ inches; barbettes, 6 inches; deck, on slopes, 4 inches, on flat, 1½ inch. **Armament:** Four 8-inch, fourteen 6-inch, eighteen 3-inch, twelve 3-pounders, eighteen smaller guns. **Complement,** 829.

LAUNCH OF THE ARMORED CRUISER "SOUTH DAKOTA" AT SAN FRANCISCO.

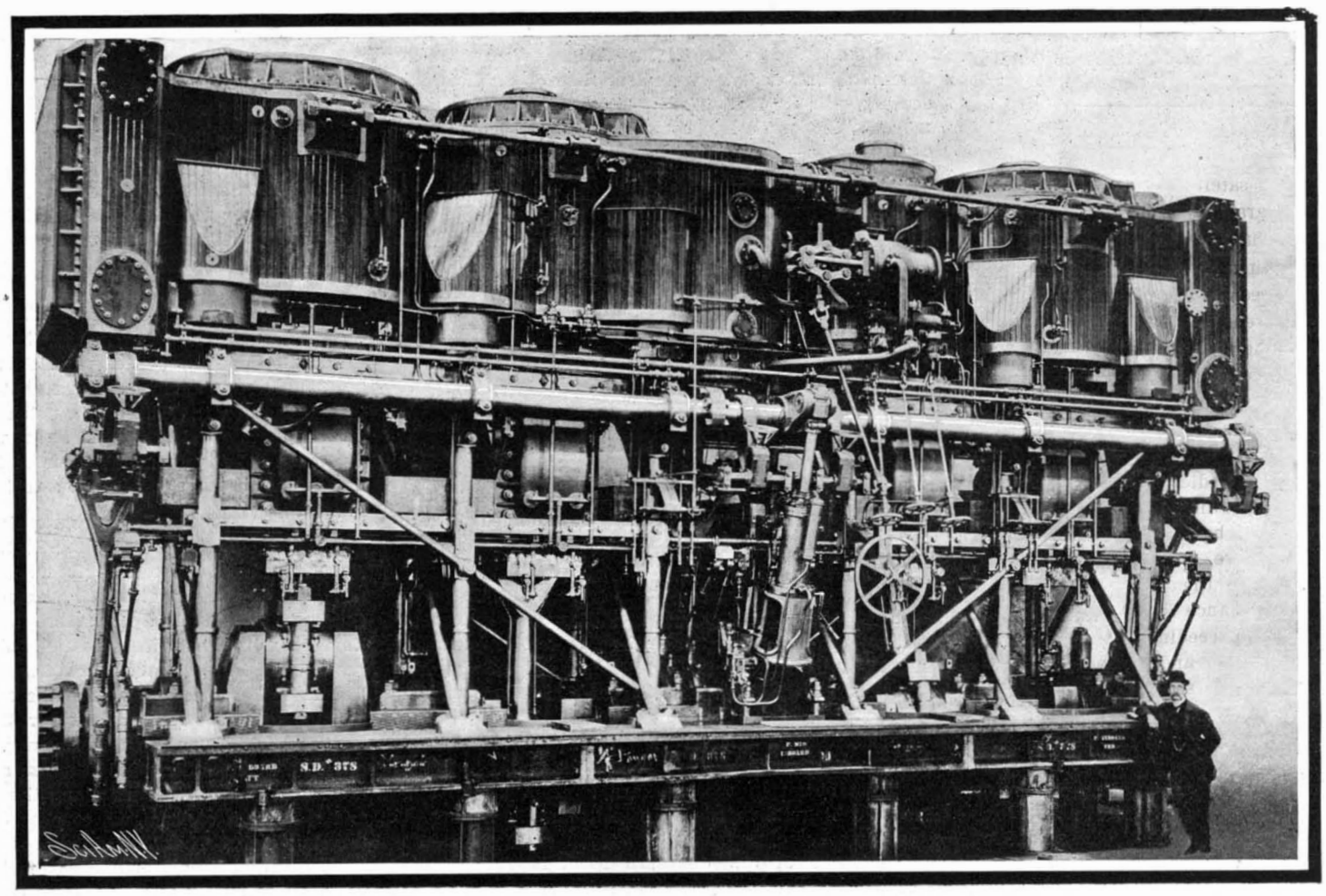
The principal dimensions of these ships are as follows: Length on load water-line, 502 feet; beam, 69 feet 6½ inches; mean draft, 24 feet 1 inch; displacement on that draft, 13,680 tons, the full load displacement on maximum draft being 15,138 tons. The distinguishing feature of the vessels as to their appearance, is the high freeboard and the long unbroken sweep of the upper deck. The protection consists of a continuous belt of Krupp armor, which varies from 6 inches in thickness for a long stretch amidships to a thickness of 3½ inches at the ends. Associated with this is an armored deck which is 1½ inches thick on the flat and 4 inches in thickness on the side slopes. For about a third of the vessel's length amidships there is a continuous wall of side armor which rests upon the 6-inch main belt, and extends to the upper deck. This armor is 5 inches in thickness throughout, and it incloses the central battery. At the ends of this side armor are transverse bulkheads 4 inches in thickness. In our illustration of the launch, the shelf upon which the bottom of the water-line armor belt rests is clearly visible. The 6-inch gun casemates have 6 inches of armor protection, while the gun emplacements for the main armament of 8-inch guns are protected by 6½ inches of armor.

There are also 9 inches of Krupp steel on the conning tower and 5 inches on the signal tower, which is placed beneath the after bridge.

The armament consists of four 8-inch, 45-caliber guns, of the latest model, which are carried in two barbette turrets, one forward and one aft, with armored ammunition hoists extending from the barbettes down to below the protected deck. The intermediate battery consists of fourteen 6-inch 50-caliber guns. Ten of these are distributed in broadside on the main deck, firing through recessed ports in the belt of 5-inch side armor. The other four guns are located on the upper deck, within casemates protected by 6 inches of steel which are placed at the four corners of the central battery. These four guns and the four guns immediately below them on the main deck are capable of being fired dead ahead and dead astern. All the 6-inch guns have small semi-circular shields fitting snugly up to the openings at the recessed ports above mentioned. The secondary battery consists of eighteen 3-inch 50-caliber guns. Four of these guns are carried on the main deck forward, four on the same deck aft, and eight of them are carried in broadside on the upper deck between the 6-inch guns. There are also a pair of 3-inch guns on the superstructure. The rest of the armament is made up of twelve 3-pounders, eight 1-pounder, two Gatlings, and six Colts. The vessel carries two submerged torpedo tubes which are located forward toward the bow.

The vessels will be driven by two sets of four-cylinder, triple-expansion, vertical inverted engines. The boiler installation consists of thirty Babcock and Wilcox water-tube boilers, having a grate area of 1,600 square feet, and a heating surface of 68,000 square feet. The engines, when running at 133 revolutions per minute, are designed to indicate 23,000 horse-power and drive the vessel at a speed of 22 knots an hour. The normal coal supply will be 900 tons; but there is a maximum coal bunker capacity of 2,000 tons. We present an illustration of one of these engines.

The "South Dakota" will carry the large complement of 829 men and her great size will make it possible to give them comfortable accommodations. A total of 2,219 tons of armor will be worked into her, and with her high speed, good battery, and coal supply, the "South Dakota" and her sisters will, no doubt, give an excellent account of themselves should they ever have to pass through the ordeal of a naval campaign.



ENGINES OF THE ARMORED CRUISER "SOUTH DAKOTA."

A NOVEL METHOD OF MAKING RELIEF MAPS.

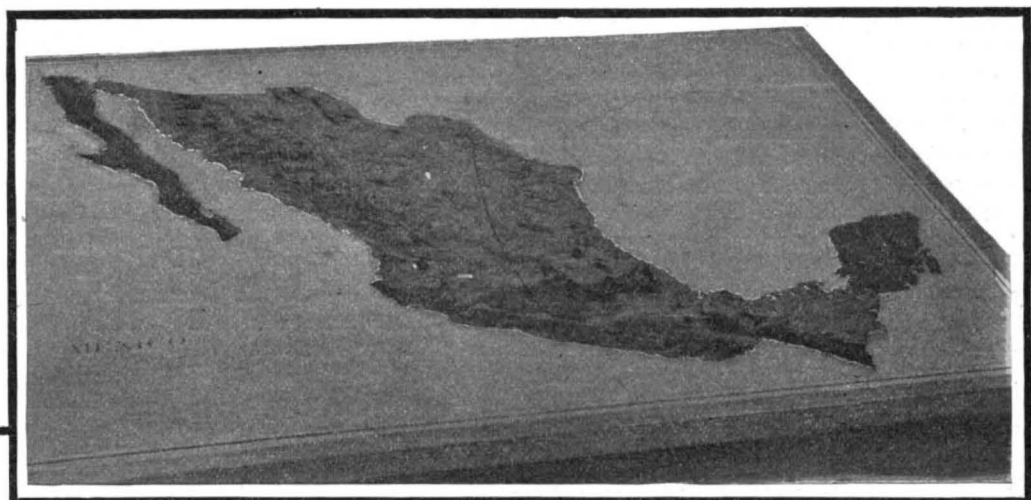
Relief maps are so frequently seen in the museums and expositions, particularly in the government exhibits of all countries, that few people realize the labor, patience, attention to detail, and skill necessary in performing the best work of this character. In the scientific, educational, and war departments of the civilized nations the importance of this branch of the topographer's art is fully recognized, and constant development and improvement are being sought after. The work in this direction that Mr. Matausch is doing at the Museum of Natural History, New York, is not yet generally known.

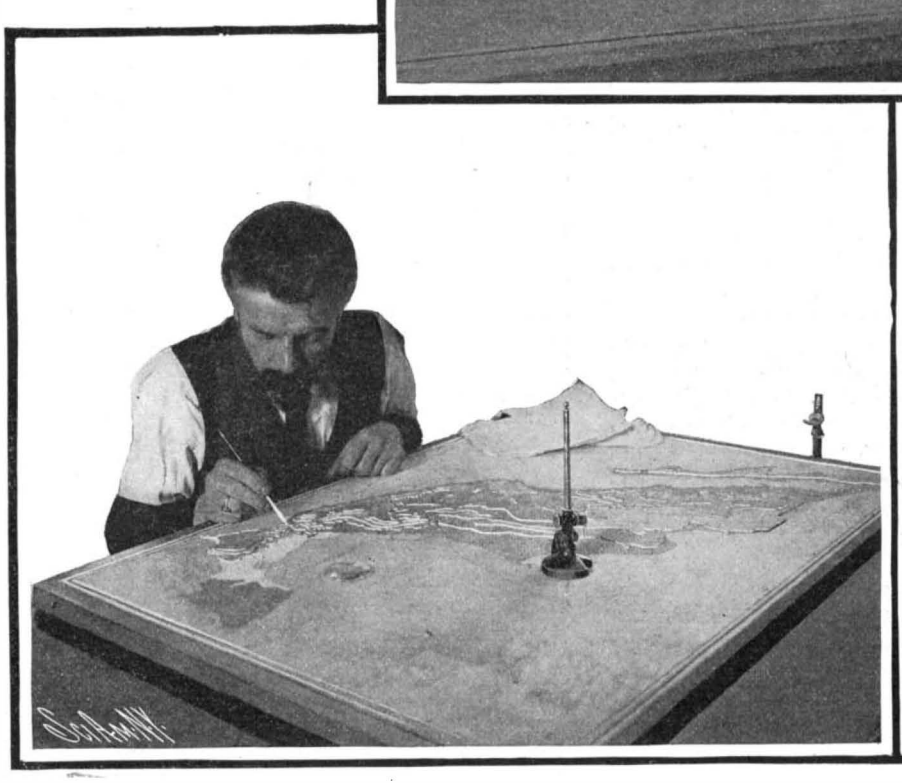
The first difficulty encountered is in the choice of a suitable scale of elevation. This scale must be such that even topographical features of minor importance are plainly discernible, while at the same time there is apparent no unnatural distortion. This scale will probably be different for almost all countries, and the success attending the construction of the map will depend largely upon the skill and judgment of the designer.

After the scale has been determined upon, a large detailed map of the country in question is smoothly glued to a level wooden surface, and layers or strata of wood or cardboard—the thickness depending upon the scale chosen—placed upon it. These strata correspond to the different elevations shown on the maps. The first or lowest, corresponding to an elevation of a few hundred feet, usually follows the coast line closely. The next is somewhat smaller in area as the elevation increases, and the outline varies with the peculiarities of the country. The following strata become smaller and smaller till the highest elevations are reached, and the mountain peaks are indicated by pegs of the proper height. A layer of clay or wax is now placed upon the strata mentioned above, and the modeling begins. Great care must be exercised in building up the gradual rise from one elevation to another, in forming the mountains and in tracing the water lines and river courses. At this stage everything depends upon the accuracy and skill of the worker alone. Mr. Matausch works from the most detailed maps obtainable, from sketches and descriptions of explorers, and where possible, from photographs. The delicacy of operation and the patience necessary in this work may be understood if we consider that the conformation, peaks, ridges and comparative size of a mountain actually 19,000 or 20,000 feet high must be shown upon a model possibly half an inch in height.

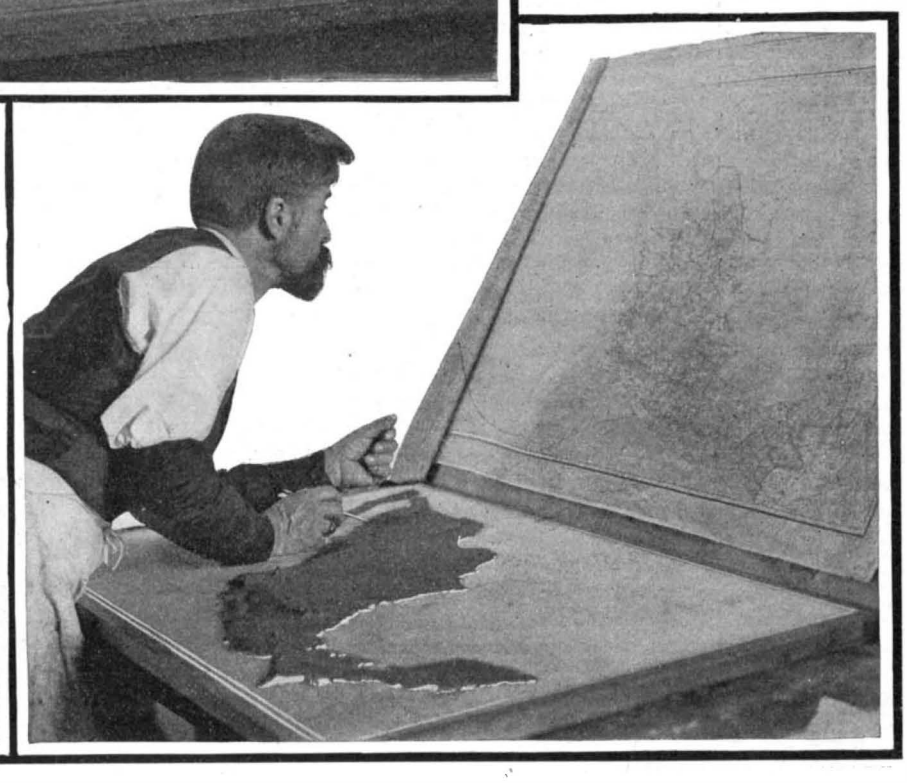
After the modeling is completed the map is varnished, and a plaster impression of it is made. By means of this plaster mold the maps which are intended for exhibition or other purposes are turned out. In making the map of Mexico, shown in the photographs, great difficulty was encountered because there are no accurate or large scale maps available of considerable portions of that country. These difficulties, however, were largely overcome by using the reports, sketches, and photographs of Bandelier and Saville, both of whom led exploring expeditions into the lesser-known parts of Mexico. As soon as the work in hand is completed, Mr. Matausch will begin a large size map of Mont Pelée and its immediate vicinity, working from data and photographs obtained from the various scientific expeditions sent to that ill-fated locality.

Ready for Varnishing and Making the Plaster Impression or Mold.





Smoothing off the Rise from Stratum to Stratum Before Putting on the Layer of Clay on which the Surface Modeling is Done.



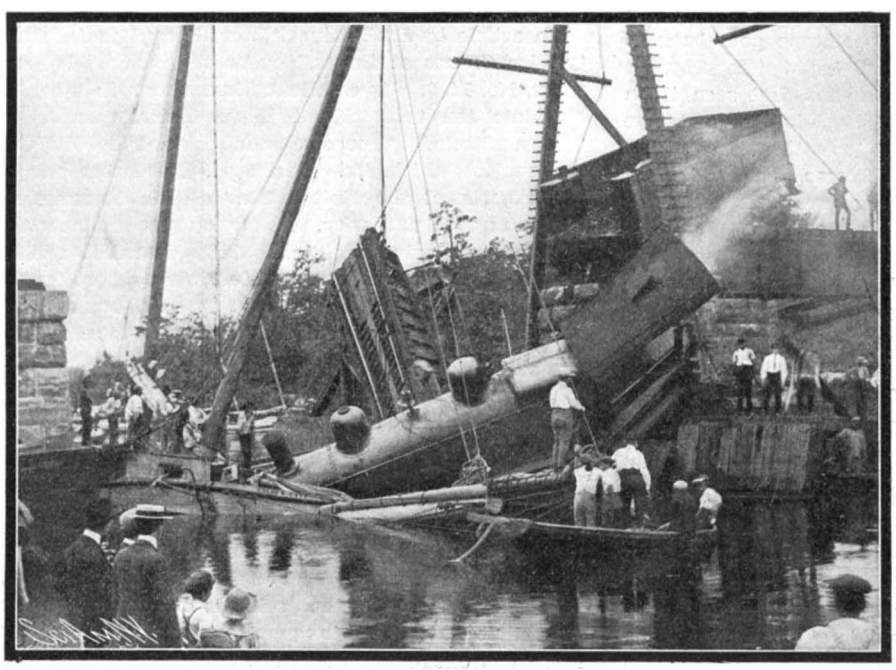
Tracing the Watercourses. The Surface Modeling is Practically Completed with This.

A NOVEL METHOD OF MAKING RELIEF MAPS.

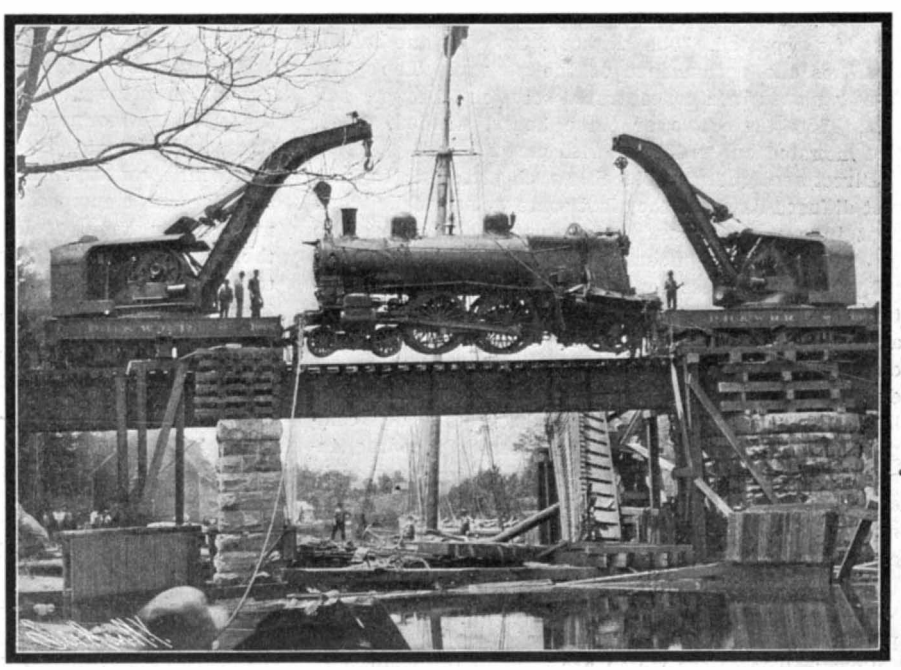
A STRANGE RAILWAY ACCIDENT.

A railroad accident attended by some very curious results recently occurred on a branch of the Philadelphia, Baltimore & Washington division of the Pennsylvania system, extending through the town of Laurel, Del. At this place the railway crosses a navigable stream on a bridge, the track being about 25 feet above the water. The bridge consists of three spans and is of the ordinary steel-girder type, the center one being the draw span. Through a misunderstanding of signals, the engineer of a passenger train ran on to the bridge before he perceived the draw was open. The locomotive fell through the draw, but fortunately the coupling between it and the tender broke under the strain, leaving the balance of the train on the bridge and the embankment forming the approach, although the tender hung over the brink.

The schooner "Golden Gate" was passing through



The Open Draw and the Wreck of the Schooner and Engine.



Two Wrecking Cranes Lifting Up the Locomotive.

A STRANGE RAILWAY ACCIDENT.

just at the time the accident occurred, and was in such a position that a novel head-on collision was the result, the locomotive striking the forward part of the vessel. Such was its momentum forward as well as downward that the front portion partly telescoped the hull, as shown by the illustration, of course sinking the schooner. One of the most difficult problems to solve was the best way of putting the engine again on the rails. Here the advantage of the wrecking crane was strikingly demonstrated, for without it the attempt would have been impracticable without the use of several cumbersome derricks. The weight was in such a position that it could not be dragged ashore, and, further, was partly buried in the hull of the vessel. Cranes were hauled to each end of the track. Two spans were temporarily placed in position to replace those damaged by the accident, the ends being supported on the masonry bridge piers and kept from shifting by false work. The cranes then took a position where the jibs extended over the vessel, and the engine was raised without difficulty, and swung upon the rails. To accomplish the feat, however, it was necessary to lift the weight of 45 tons to a height of 30 feet and swing it laterally about 10 feet.

DIRECT PHOTOGRAPHY IN NATURAL COLORS ON PAPER.

It is not a new idea to found, on the basis which Herschel established in the beginning of the forties, a process which has for its purpose the isolation by the action of light of single colors from a color-mixture. Davanne, Dr. Wiener, and others have written on the subject, and E. Vallot announced in 1895 that he had succeeded in obtaining corresponding colors by allowing sunlight to act for three or four days through colored glass on paper impregnated with the three fundamental colors.

I concluded to experiment in this direction, and especially to strive to obtain the bleaching by light in the shortest possible time by means of additions to the color mixture, writes an unknown author in Photographische Chronik. I found that various ethereal oils heighten the light-sensitiveness of organic coloring matters to a very considerable degree; oil of anise is especially effective, and the principal effect is due to the anethol contained in this oil. I continued these experiments, and arrived at the following process:

Writing paper free from wood is drawn through a bath which consists of a mixture of alcoholic solutions of primrose, Victoria blue, cyanin, curcumin, auramin, and an addition of anethol. The test of the proper constitution of this bath is made by exposing a sensitized strip of paper under a test negative composed of red, yellow, green, and blue strips of glass. If the composition is correct, exposure in sunlight must cause all the colors of the test negative to appear on the strip of paper. The bath must be kept at a temperature of 20 deg. C. (68 deg. F.) The sensitized paper is hung up to drain and allowed to dry at the same temperature.

It is exposed in a printing frame as soon as surface-dry, either under a picture of colored glass, or under a transparency, or under a colored lantern slide. Every delay diminishes the sensitiveness of the paper to light, so much so, indeed, that even an hour after preparation it has become considerably less sensitive. The exposure in perpendicularly-falling, full, clear, sunshine varies according to the transparency of the negative, the strength and anethol content of the bath, and the intensity of the light. Under favorable conditions I have obtained good results in five minutes.

When the picture appears clearly in all its details of color, the exposure is finished. The print is then washed in pure benzol for an hour and dried at about 30 deg. C. (86 deg. F.) If the odor of anethol can still be detected after this procedure, the benzol bath must be repeated. The slightest trace of anethol diminishes the permanence of the picture. The print is now placed in a concentrated solution of copper sulphate, left there two or three hours, washed, dried, and mounted on cardboard with paste.

Direct sunlight soon bleaches such pictures. In indirect diffused daylight they last some weeks, while when kept in a portfolio and only occasionally exposed to light, they remain unchanged for years.

By the use of less concentrated baths and the addition of a very large quantity of anethol, pictures of artificial flowers can be directly obtained in the camera by the use of lenses of very large aperture. I expose for this purpose about two hours in direct sunlight. The colors appear somewhat weak, but completely recognizable even to the green. Of course, instead of paper one can use glass plates previously coated with collodion or gelatine, for this process. The results, however, are much inferior to those obtained on paper.

This process has one disadvantage, that the shadows which are black in the transparency, appear on the prints not black, but brown. The cause of this is as follows: The colors which are used in the color bath behave differently toward light, that is, they do not bleach in the same time. Yellow fades most quickly, red next, and blue least rapidly. Therefore, in order to isolate all colors in purity after a given time, yellow must predominate and red overbalance blue in the color mixture. For this reason the tone of the color mixture and the paper is not black, but brown. Since the opaque parts of the transparency protect the paper from bleaching, it remains under the black parts in its original color, that is, brown instead of black. In the course of the year 1902 I tried to remedy this disadvantage by first making a platinum print from the negative, then sensitizing this in the color bath, and exposing under the colored negative. These prints appear incomparably more beautiful, with deep black shadows. The experiments have further shown that the light-sensitiveness of the paper depends essentially on the nature of the fibers of which the paper is made. The most suitable are flax fibers without any other admixture, and therefore Whatman papers are to be preferred to all others. Since, however, they possess a much greater capacity of imbibition, it is preferable not to draw such papers through the color solution, but to coat the paper with the solution by means of a stiff brush.

Although the anethol shortens the time of printing very considerably, I was desirous of still further increasing the sensitiveness to light. After numerous experiments with oxidizing and reducing substances, I found that some resinates possessed the property, in the presence of anethol, of still further increasing the light-sensitiveness. These experiments are not yet concluded, and it is to be hoped that with the help of these substances a very considerable sensitiveness, and therefore a wider applicability of the process, may be attained.

Correspondence.

The Black Race and the Sun.

To the Editor of the Scientific American:

In reply to the query of Prof. E. G. Dexter as to why negroes are able to withstand the effect of the sun's rays better than those with white skins, though black absorbs heat far more readily than any of the colors, might it not be well to test the power of the black matter in the negro's skin to resist the passage of the invisible or X-rays of the sun? Possibly we are unfavorably affected by the sun's less-known influences, and the dark races have been provided with just the right kind of shades to protect their bodies from them.

O. R. Washburn.

Pocantico Hills, N. Y., August 20, 1904.

The Two-Headed Eagle.

To the Editor of the Scientific American:

In your issue of June 11 in "Science Notes," speaking of the two-headed eagle, you say: "The symbol of the two-headed eagle is considered by some heralds to be merely the result of the heraldic practice of 'dimidiation' which crept into English heraldry during the reign of Edward I. . . . It robs the two-headed eagle of half its terrors to know that it owes its origin to this sort of child's play."

It happened that at the same time I was reading "The Hittites; The Story of a Forgotten Empire," by Prof. A. H. Sayce, LL.D., D.D., the famous authority on eastern antiquities; and I find that in this book he gives an illustration of the sculpture of a two-headed eagle, with the following remarks: "The same block of stone . . . bears also on the inner side the figure of a double-headed eagle, with an animal which Prof. Perrot believes to be a hare in either talon, and a man standing on its two-fold head. The same double-headed eagle, supporting the figure of a man or a god, is met with at Boghaz Keni, and must be regarded as one of the peculiarities of Hittite symbolism and art. The symbol, whose prototype goes back to primitive Babylonia, was adopted in later days by the Turkoman princes, who had perhaps first seen it on the Hittite monuments of Kappadokia; and the Crusaders brought it to Europe with them in the fourteenth century. Here it became the emblem of the German emperors, who have passed it on to the modern kingdoms of Russia and Austria. It is not the only heirloom of Hittite art which has descended to us of to-day." Perhaps this quotation, showing the immense antiquity of the symbol, may prove of interest and information to some of your readers.

C. E. Cook.

Cape Town, South Africa, July 21, 1904.

A Comment on Prof. Dexter's Theory.

To the Editor of the Scientific American:

In your issue of August 20 Prof. E. G. Dexter finds what seems to him a contradiction in nature's laws, according to which the heat-absorbing black pigment is placed in the skin of the dwellers in tropical regions, while the light-skinned races dwell in cold climates. He says: "The sensible effect of direct sunlight upon the negro should be more intense, by several degrees, than upon the white man. Why is it?"

May not the explanation be that since it is true, as he states, that black is a better absorber of heat than white, it is therefore also a better radiator, and that the people in the tropics need to lose or radiate away from the body the heat produced in it by the chemical processes of life, while the people in colder regions need to preserve that heat in the body? As the mercury climbs up toward 90 deg. F. the heat becomes oppressive, and we seek the shade and the breeze, and endeavor to cool the body. Heat prostrations begin to take place before the external temperature has reached 98 deg., or the temperature of the body. When the thermometer goes above that, it is only with care that we can exist at all, and continual subjection to such heat, or to the direct tropical rays of the sun, would speedily be fatal. The average temperature, even in the tropics, must be below 98 deg., or life could not continue, but on the approach to it the body must be cooled. Radiation is one method of cooling. Hence the black pigment, that assists this radiation. In cold climates, on the contrary, nature gives white, a poor radiator, to retard the loss of heat by radiation, just as the wool of animals in cold climates retards radiation, while the bare skin of the elephant, in the tropics, assists this cooling process.

E. P. Foster.

Cincinnati, August 22, 1904.

Effect of the Sun Upon the Black Race.

To the Editor of the Scientific American:

I read with much interest the inquiry, at page 126, respecting the black race, and believe to have found a sufficient and simple declaration that the home of the black race is the tropic zone, and of the white the moderate zone, though the black color is a greater absorber of the heat than the white.

For scientific and historical reasons the hypothesis seems to be right that the birth of whole mankind happened at one single place, at the frontier of both zones, supposed in Asia. In the later development of human beings, the different races appeared. Now, the principal reason that the home of the colored men is to be found in the tropic zone seems to me the fact that the normal temperature of blood of man is about 100 deg. Fahrenheit. The white color is protecting the man more from leaving this temperature of blood, far higher than the average temperature of the moderate zone, than the black color. Therefore the black people felt inclined themselves by this natural reason to go to the hotter countries, where the temperature is more adequate to the temperature of the blood. Moreover, the development of their nervous system helped them to stand the tropic heat.

Meanwhile, there is the question, for what reason, the white race or a part of them did not also take their refuge to the tropic part of the earth. But, it is a fact, documented almost by every found from their early times of mankind, that the history of this age consisted in an epoch of continual fights between the single tribes, and especially races. Every people sought his own country, his own pastures, his own hunting grounds, and did not suffer any one in them, like most savages do in our days. In this struggle, the negroes succeeded in securing for themselves the tropic countries, more adequate to them, leaving the moderate zone to the white race, without counteracting their prosperity. The white nations could live in the colder parts of the earth, because the white color protected them against the influence of coldness.

These natural and historical reasons will completely give the answer upon the above inquiry.

Herman Gumpel.

Philadelphia, Pa., August 21.

The Current Supplement.

An article by Emile Guarini, entitled "The Admiralty Pier Cranes at Dover," opens the current Supplement, No. 1496. Its excellent illustrations do much to elucidate the text. Mr. William Metcalf writes on "Alloy Steels," "Porpoise and Black-fish Oils" is the subject which Mr. Charles H. Stevenson, one of the experts of the United States Fish Commission, discusses with authority. A suction gas producer for use with explosive engines, is fully described and illustrated. Mr. W. Ripper concludes his report on the Mosely educational commission. The St. Louis correspondent of the Scientific American writes an instructive article on the historical exhibit at the Electricity Building at the Exposition. Three pictures of historical inventions accompany the text. Other articles from the same pen are entitled "A Fine Exhibit of Welded Steel Plate," and the "Big Twenty-Foot Wooden Pulley in the Machinery Building." Mr. I. Wilbert contributes an article of much value to the history of the rise and development of chemical industries in America. Professor James Dewar discusses in his usual exhaustive way the problems of the atmosphere. An article which contains many a curious bit of information is one which bears the title "Plants as Builders." The similarity between the forms adopted by Nature in her constructive processes and those devised by ours is striking.

A NOVEL CANAL LIFT AT FOXTON.

(*Continued from first page.*)

presence of locks at frequent intervals throughout the course, the negotiation of which occupies considerable time and militates against the rapid progress of the traffic plying upon the waterway.

To overcome this severe disadvantage a novel system of communication has been devised by Messrs. Gordon and James B. Thomas, of England, and is now in operation at Foxton, Leicestershire. The object of this invention is to completely abolish the locks and employ mechanical means of raising or lowering the boats from one level to another.

The Grand Junction Canal was formerly a busy waterway, but so severe has been the competition of the railroad that its traffic has considerably diminished. At this particular point there is a difference in the level of the waterway of 75 feet. To ascend or descend from one level to another a staircase of ten locks had to be negotiated. Naturally such an elaborate locking arrangement, which was, however, unavoidable owing to the difference in the levels, occupied considerable time. In fact, the shortest time in which a single boat could be passed from one level to another was 1 hour 15 minutes, and 1 hour 20 minutes for two boats. This lengthy operation therefore not only handicapped the rapid transit of the barges, but the number of boats that could be passed during the day was also strictly limited.

For the purpose of improving and accelerating the system, Mr. Gordon Gale Thomas, the engineer in chief to the Grand Junction Canal, in conjunction with his brother, devised the present lift system of communication. The work of carrying out the installation was intrusted to the engineering firm of Messrs. Gwynne, of Hammersmith, London, through whose courtesy we are indebted for the photos illustrating and the information contained in this article.

The principle of the invention, as will be realized from the accompanying illustration, is two barge lifts running in opposite directions upon the counterbalancing system.

An inclined plane 300 feet in length has been laid from the lower to the higher reaches. Upon this is laid eight pairs of rails, four for each lift. The gradient is in the proportion of 1 in 4, and the total height is 75 feet. The plant comprises two movable tanks, or lifts, two fixed conduits, hydraulic gates and rams, steam engines and boilers, hydraulic pump, water accumulator, steel wire haulage ropes, hauling drums, guide pulleys, etc.

The two movable tanks are constructed of steel plates. Each lift is carried upon eight sets of wheels, which run upon the tracks. The internal dimensions of each tank are 80 feet in length, 15 feet in breadth, and 5 feet in depth. These tanks are each capable of accommodating two canal boats of 33 tons apiece, or one barge carrying 70 tons. The depth of water in the lifts is sufficient to float the barges within. At each end of the tank is provided a gate or sluice, which is raised to the top of the steel frame provided for the admittance and egress of the boats within the lift. These gates are completely watertight, so that no loss of water is incurred during the passage of the lift up or down the inclined road, and no danger to, or strain upon, the boat is incurred.

The two tanks travel in opposite directions; i. e., while one is ascending the other descends, and *vice versa*. They are connected by wire ropes in such a manner that the weight of one balances that of the other as they travel up and down in opposite directions between the higher and lower canals. Even if only one lift is loaded it makes no difference, for the other contains its full complement of water, and the boat within the one lift only displaces its own weight of water. By this arrangement the engine has no work to do beyond overcoming the friction of the working parts.

On the upper reach at the end of the track are two fixed conduits forming the ends of the canal to support the necessary gates and face fits. The lower end of the inclined plane terminates in one case in a small dock. In both cases the track is continued into the water, so that the lifts are submerged to a depth such that the level of the water within the lifts corresponds to that in the canal. An entrance of the same width as the tank connects the canal waterway with the first dock. As may be seen in the illustration, the outer arm of this dock resembles a pier alongside the outer side of which a barge can be moored to await its turn, thus leaving an open fairway between the tank and the canal.

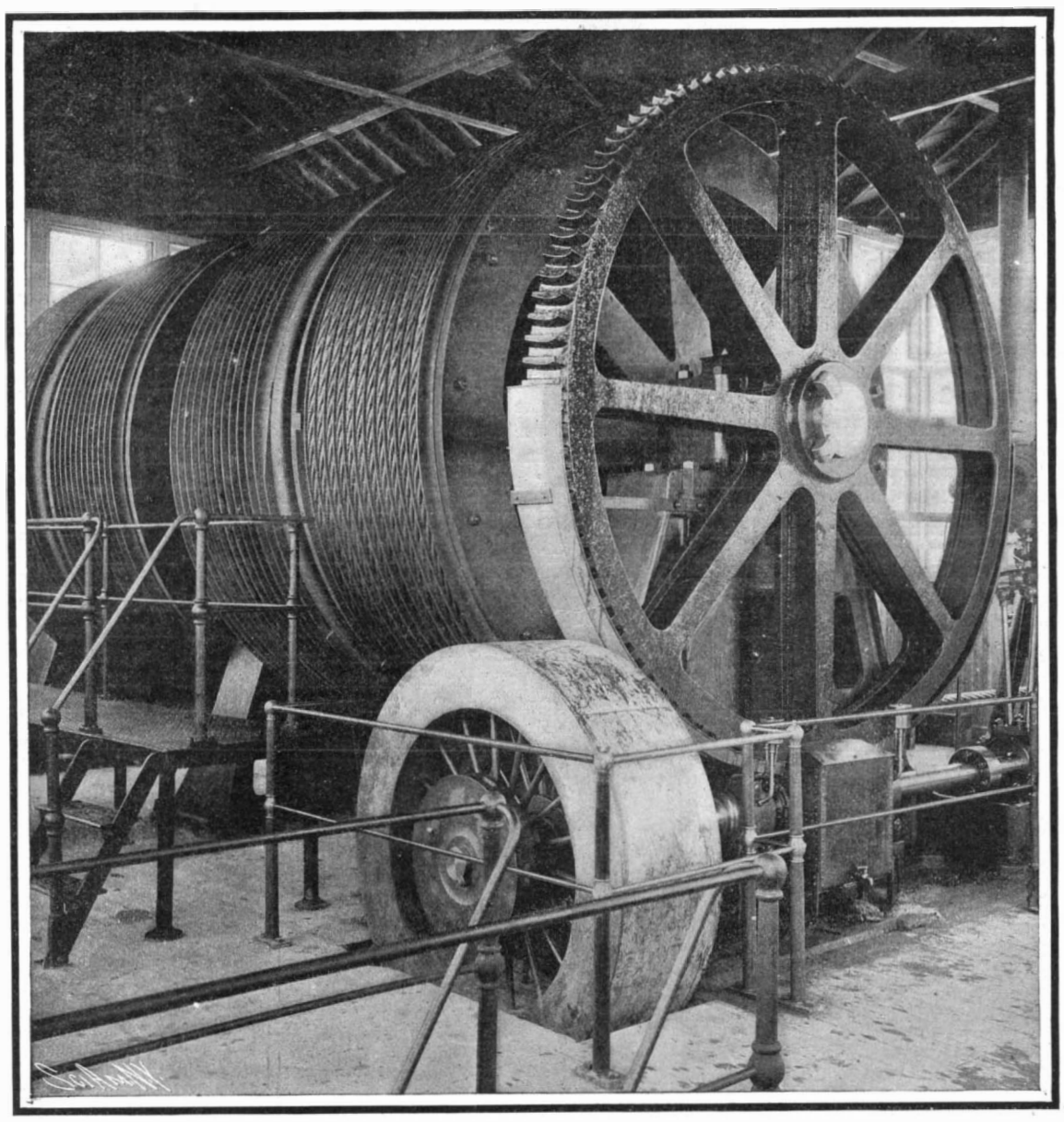
The power house which contains the controlling mechanism of the lifts is located upon the higher level.

The wire haulage cable connecting the two lifts, which is 7 inches in diameter, is passed round the main hauling drums and guide pulleys. These are operated by an engine of the double-cylinder jet-condensing type, the drums being driven through powerful worm gearing. This engine also drives a horizontal duplex hydraulic pump having outside bucket plungers. This plant delivers water into an accumulator of sufficient capacity to contain a reserve of water adequate to operate all the necessary cylinders simultaneously. Steam is raised in a boiler of the Lancashire type, of which there are two, though, as one is ample for the work, the second boiler is simply held in reserve.

The method of operating the lifts is as follows: A barge is awaiting transferance from the bottom to the upper reach. The tank is in the submerged position in the lower canal. The gate of the lift is raised, and the boat is towed into the tank and berthed. The gate is then closed by means of hydraulic cylinders. The machinery is set in motion and the loaded lift is hauled up the inclined plane, the second lift meanwhile descending. During the passage the boats float in the lift, and consequently, being water-borne throughout the whole operation, neither they nor the sides of the tank are strained in any way.

Upon the arrival of the lift at the top it is not submerged, as in the lower reach. The tank is held firmly in position, and the lift is forced up against a face by hydraulic cylinders, thereby insuring a perfectly water-tight joint between the end of the tank and the end of the canal. Both gates, that is to say, the gate which constitutes the end of the tank and the gate which closes and forms the end of the conduit of the canal, are raised simultaneously by hydraulic cylinders. Connection between the tank and the canal is thus established. As the levels of the water in the tank and the canal are identical, the boat simply has to be floated out and continue its journey. To lower a barge from the upper to the lower canal the process is simply reversed. It will be observed, however, owing to the ingenious system of the invention, that either tank is precisely of the same weight either simply with water or a barge, so that perfect balance is maintained. In order to dispense with manual labor, all operations are carried out mechanically. In fact the operation of the lift only necessitates the attendance of three men.

The main advantages arising from the utilization of this system are two-fold. First, there is a great saving of water, and secondly, there is great economy of time. The saving of water approximates 90 per cent of the quantity used by the locking system. The economizing of time is even greater. Instead of occupying 1¼ hours for the passage of a boat, as was formerly the case, through the staircase of ten locks, a barge can be transferred from one level to another in 12 minutes. It will be realized also that under these conditions a far greater tonnage can be passed from one level to the other by this process than with the previous system. Taking 15-minute intervals between the operations, 6,000 tons—3,000 tons in either direction—can be passed through in a working day of 12 hours. The cost of working on this basis has averaged $6.10 per day, which sum is inclusive of coal, oil, stores, and labor.



Interior of the Power House, Showing the Main Hauling Drums and Cable.

Artificial Rubies.

Artificial rubies are made by a process of the chemist Verneuil, by melting a mixture of clay and oxide of chromium at an even temperature of several thousand degrees. The two substances are carefully placed above each other in layers so as to prevent cracking in the crystallized mass.

It is stated that Verneuil finally succeeded in producing an artificial ruby weighing 5 pounds, which had a value of about $600. From this price it may be judged that the product is not first class, and probably just pays the cost of manufacture. In order to produce the exceedingly high temperature which is indispensable for success, Verneuil uses a blast of oxyhydrogen gas, which acts directly on the mass from the top. The hardness of the ruby is the result of quick cooling caused by sudden interruption of the blast of oxyhydrogen. The artificial ruby is said to be very pure and brilliant, possessing all the physical properties of natural rubies. It can be cut, and takes a very fine polish. In view of these assertions it seems singular that artificial rubies have no higher value, especially as the natural article is so exceedingly high-priced at present.

An exciting incident occurred during some experiments that were being carried out by Col. Cody with his man-lifting kites at Bradford, England. Three kites were sent up to a height of 2,000 feet from a steel wire. Then another kite carrying a man was sent aloft along the connecting wire, to attend to the first kites, which were somewhat troubled by the strong wind which was blowing at the time. At an altitude of 1,500 feet the kite carrying the man was caught by a gust of wind and torn to ribbons. The man immediately began to fall, bringing the three pilot kites with him. The man fell at an alarming speed, but the operators succeded in steadying the kites, and the man alighted safely upon the roof of a house 300 yards away, considerably shaken up, but little the worse for his thrilling experience.

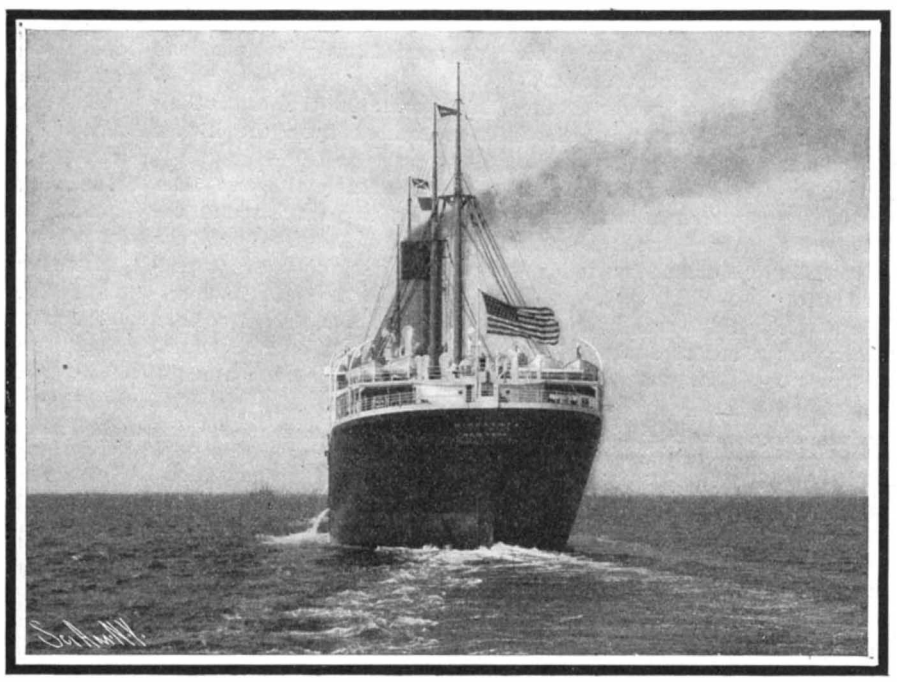
The average life of the uranium atom is calculated by J. Joly to be 10^{9} years—a period one hundred times greater than the period allowed for the development of the geological strata.

THE "MINNESOTA," THE LARGEST STEAMSHIP EVER BUILT IN AMERICA.

Quite a flutter of excitement was caused in maritime circles in this city and among those laymen who take an interest in shipping, by the arrival at the port of New York of the great steamship "Minnesota," the largest freighter ever built in America and the fourth largest steamship in the world. She came to this port direct from New London, where she was built, and during her brief stay she was thrown open to inspection by the public. After leaving New York she sailed for Newport News, where she will be dry-docked and cleaned; then she will return to Philadelphia for a cargo of 10,000 tons of coal, from which port she will start on her long journey around the Horn to San Francisco and Seattle. The latter city is to be her home port. The "Minnesota" is one of two twin ships that have been built for the Pacific trade, to run in connection with the Great Northern Railroad, which has its Pacific terminus at Seattle. A curious feature in connection with these ships is that an entirely new company was formed expressly for the purpose of constructing them. A site was selected at New London, a plant for their construction was erected, and the two ships have been pushed through steadily to completion.

The "Minnesota's" principal dimensions are: Length, 630 feet; breadth, 73 feet; molded depth, 56 feet. On a draft of 36½ feet her displacement would be 37,000 tons. The only vessels that are larger than the "Minnesota" are the "Celtic" and "Cedric," which are 700 feet in length by 75 feet in breadth, and of about 1,000 tons greater displacement, and the "Baltic," recently illustrated in this journal, which is 725 feet in length, and has a total displacement of about 40,000 tons. That the "Minnesota," with her smaller dimensions should so nearly approach the big White Star boats in displacement is accounted for by the fact that her lines are very much fuller, the vessel more completely "filling the block" than the finer-lined and somewhat more speedy White Star vessels.

The most remarkable feature of the new ship, and the one that made the deepest impression on the visitors, was her great depth, the effect, when looking down through the upper deck hatchway to the ship's inner bottom below, being most impressive. From the outer bottom to the navigating bridge there are eleven distinct decks or platforms. First there is the outer bottom of the ship; 6 feet above this is the inner bottom or floor; then follow the crlop, the lower, the between, the main, and the upper decks, all of these decks being contained within the plated structure of the vessel, and every one of them being built of steel plating. The whole inclosed structure is 56 feet in height. Above the upper deck are the promenade deck, the upper promenade deck, and the boat deck, the boat deck being 25½ feet above the promenade deck or 81½ feet above the keel; while another 8 feet above this, or 90 feet above the keel, is the navigating bridge. Now, since the vessel at her full draft will draw 33 feet, it follows that the navigating bridge will at that draft be 57 feet above the water-line. In the light condition in which she entered New York harbor, she drew something less than 20 feet, consequently the navigating bridge was about 70 feet above the water, and the passengers on the upper promenade deck were about 62 feet above the water-line. When we remember that the heaviest waves seldom exceed 30 feet in height, it follows that in the stormiest weather the passengers on the Pacific will be able to look down upon the Pacific rollers from a point of observation 30 feet above their crests. Accommodations are provided for fifty first-class passengers, a hundred second-class passengers, one hundred third-class passengers, and a thousand steerage. There are also quarters for the accommodation of twelve hundred troops, while the total cargo capacity is 20,000 tons.



View from Astern, Showing the Great Beam.

The new vessel embodies several new principles of construction, and is considerably stiffer and stronger than any vessel heretofore built for the American merchant marine. The outer plating of the ship's bottom is of 1¼-inch steel, and the shell plating is strengthened by an additional strake of 1-inch plating at the main and upper decks, while continuous 1-inch stringer plates are worked from stem to stern along these two decks, as a stiffening to the regular deck plating, which, on the main deck, is 16-20 of an inch in thickness, and on the upper deck is 18-20 of an inch. The ship is strengthened against hogging and sagging strains by a continuous central longitudinal bulkhead, reaching from the keel to the upper deck. This is the first case that we know of a vessel being constructed with a complete, central bulkhead of steel from upper deck to keel and from stem to stern. The ship also acquires great longitudinal strength from the new system on which the stanchions and girders are built in. Instead of using a large number of ordinary pipe or tube stanchions, placed at frequent intervals, there are three lines of heavy box section stanchions, measuring 13 x 12 inches in section. These stanchions are placed 20 feet apart longitudinally, and the deck loads of the deck above each series are carried to them by means of continuous lines of 13 x 24-inch box girders. This is not only an economical distribution of material, but it adds greatly to the longitudinal stiffness of the vessel. The longitudinal bulkheads necessitate double hatches, and there are in the ship no less than fourteen cargo hatches. There are four or more derricks at each mast, and there are four independent derricks in addition, so that the facilities for loading and unloading the ship are exceptionally good.

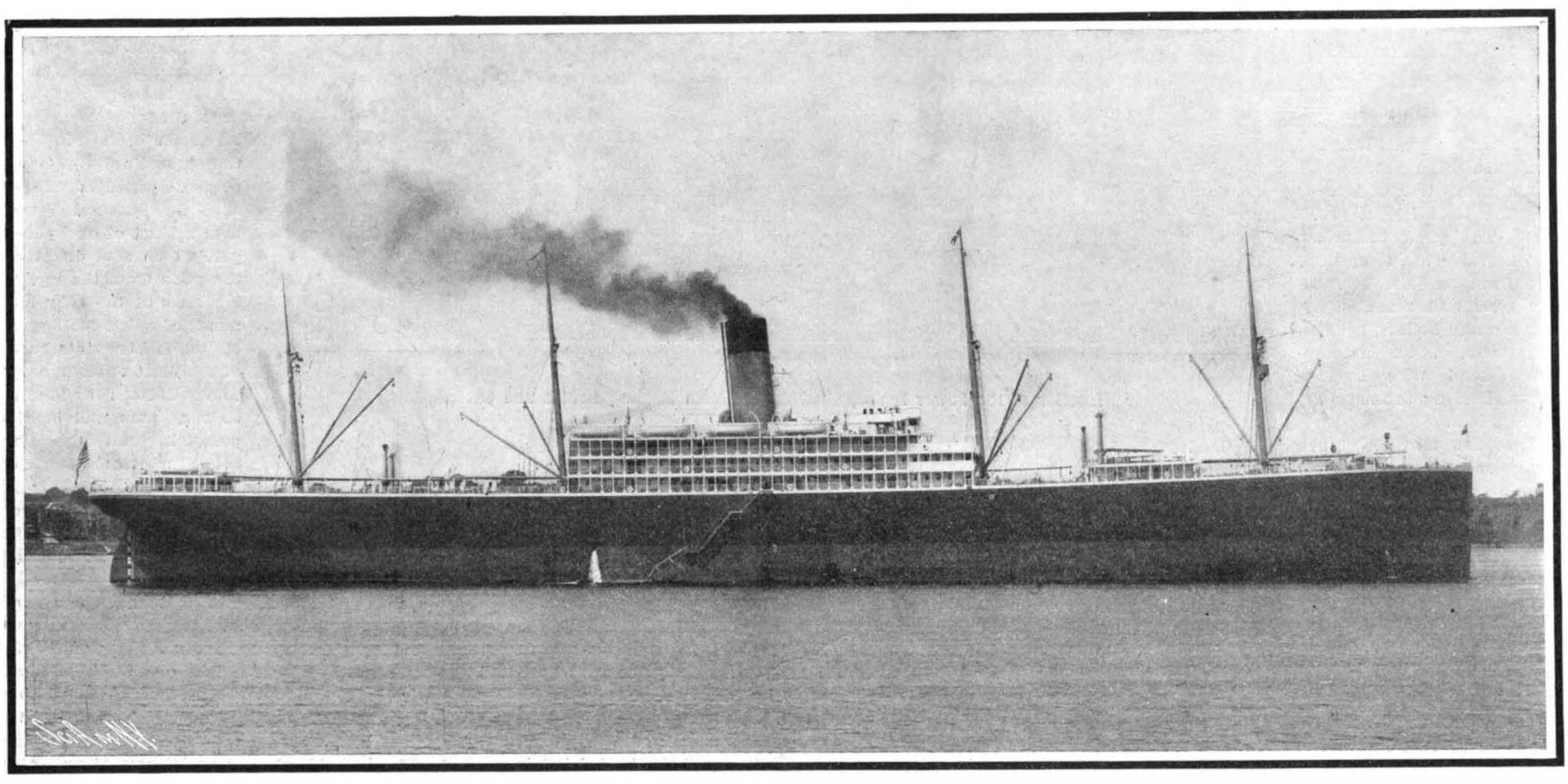
The vessel, as we have stated, was designed to meet the special requirements of the Oriental trade, and one of the hatches is made sufficiently long to enable a locomotive to be loaded complete into the hold. The sea speed of this fine vessel is about 15 knots an hour.

The latest measures of the aurora spectrum, made from photographs obtained by Sykora at Spitzbergen in 1899, are compared by E. C. C. Baly with lines of similar wave-length in the spectrum of krypton, produced by an induction spark on the gas in an exhausted tube. The krypton lines are given with much greater accuracy than those of the aurora, owing to the difficulty of observing the latter. From the apparent coincidences of the constituent wave-lengths it is considered as probable that a close connection exists between the two spectra.

EXPRESS ENGINE AND TURNTABLE IN THE TRANSPORTATION BUILDING.

BY THE ST. LOUIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

A striking novelty in the Transportation Building is a powerful express locomotive built for the "Big Four" road, which is shown mounted upon a plate-girder turntable, both the engine and the turntable



Length, 630 feet. **Beam,** 73 feet. **Displacement,** 37,000 tons on a draft of 36½ feet. **Speed,** 15 knots.

THE "MINNESOTA," THE LARGEST STEAMSHIP EVER BUILT IN THE UNITED STATES.

being in constant operation. The driving wheels moving at a rate equivalent to a speed of about 20 miles an hour, and the turntable with its heavy load of 163 tons moving majestically around upon its axis combine to make a decidedly striking effect. The engine is a splendid example of the modern Atlantic type turned out by the American Locomotive Company. The cylinders are 20½ x 26 inches, driving wheels 79 inches, and its total weight in working order is 184,000

pounds. The diameter of the boiler is 68⅜ inches, the total heating surface is 3,196 square feet, grate area 44.8 square feet, and the boiler pressure 200 pounds to the square inch. The maximum tractive power is 26,000 pounds. The tender weighs 140,000 pounds and has a capacity of 7,500 gallons of water and ten tons of coal.

The turntable, which is an excellent job of riveted plate steel work, consists of two plate-steel girders, one under each rail, 5 feet in maximum depth and 70 feet in length, which are heavily braced together vertically and laterally. It runs upon a base which is 12 feet in diameter, and it stands 4 feet above a hemispherical mound, erected upon the floor of the building. The engine is raised sufficiently for the driving wheels to clear the track by 3-16 of an inch, the supports consisting of four heavy castings, which reach from the rail to the engine frames, to which they are bolted. The driving wheels of the engine are run by an 18-horse-power electric motor, the wheels being carried in Babbitt cellars in the driving boxes. The turntable is also rotated by an 18-horse-power motor, the current being taken by two bus-bars which extend around the base near its top. The mound upon which the turntable stands is painted to represent on one side the "Big Four" route, and on the other side the various lines with which the "Big Four" route has connections. Altogether this is one of the most imposing exhibits in the Transportation Building.

FESTIVAL HALL AND THE COLONNADE OF STATES —THE ARCHITECTURAL MASTERPIECE OF THE LOUISIANA PURCHASE EXPOSITION.

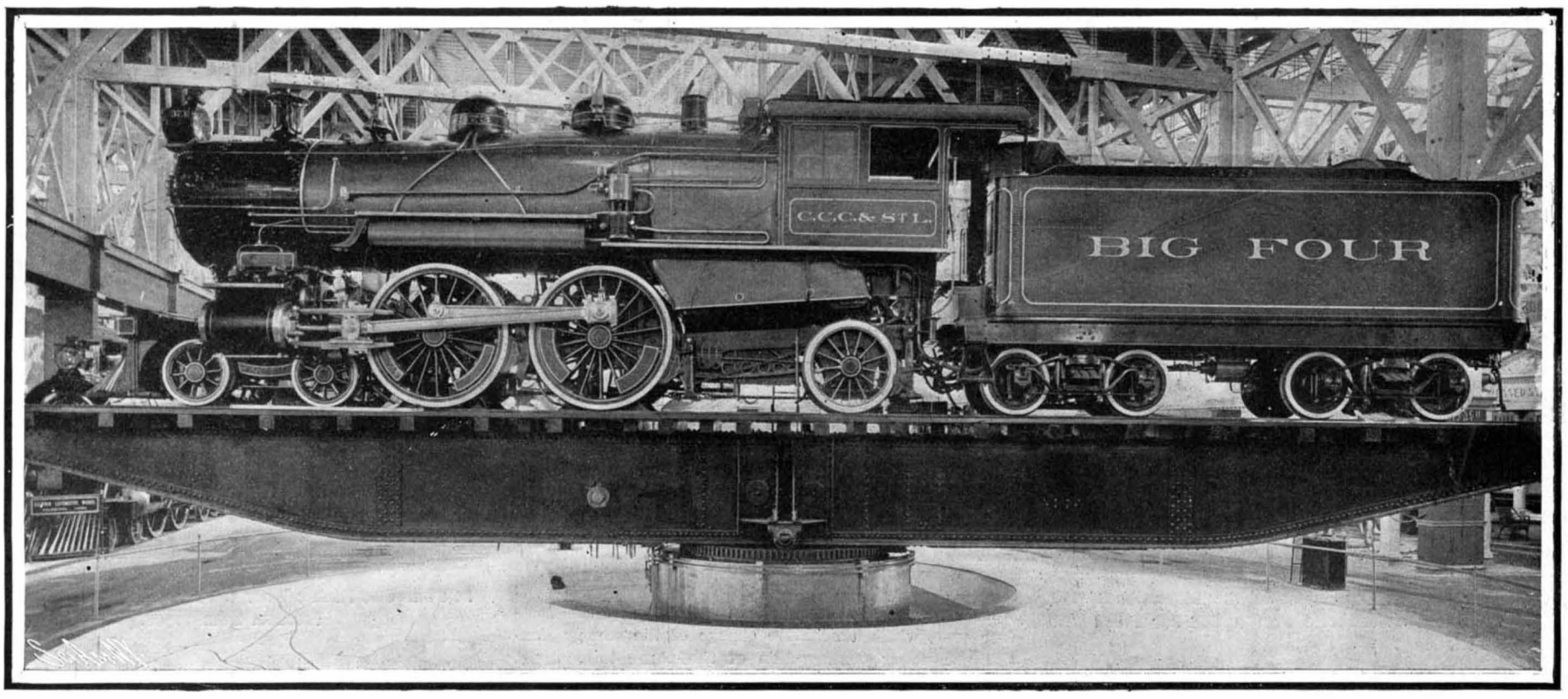
BY THE ST. LOUIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

It is not often that the photographer is presented with such a fine opportunity to show what the camera can do in the reproduction of architectural and landscape effects as is provided by the prodigal wealth of architecture, statuary, cascades, and floral landscape that renders Festival Hill the chief glory of the Exposition at St. Louis. Festival Hall and the Cascades are beautiful at any hour of the day; but they are seen at their best when the sun has passed the meridian and the afternoon is well spent; for then it is that exquisite contrasts of light and shade serve to accentuate the rich profusion of detail in the buildings, and cause the statuary to stand out in all its pure white beauty against the rich green of the sloping lawns, and the brilliant coloring of the flower beds; while the shafts of sunlight that steal through the many-columned stretch of the Colonnade give a touch of rainbow beauty to the fountains and cascades.

Visitors to the fair who have seen the famous architectural panoramas of the Old World do not hesitate in pronouncing this scene the most beautiful and imposing of them all. It is an artist's dream, and like a dream it must soon vanish; for the wrecker and the junk man are already estimating what it will be worth to them as rubbish and old lumber.

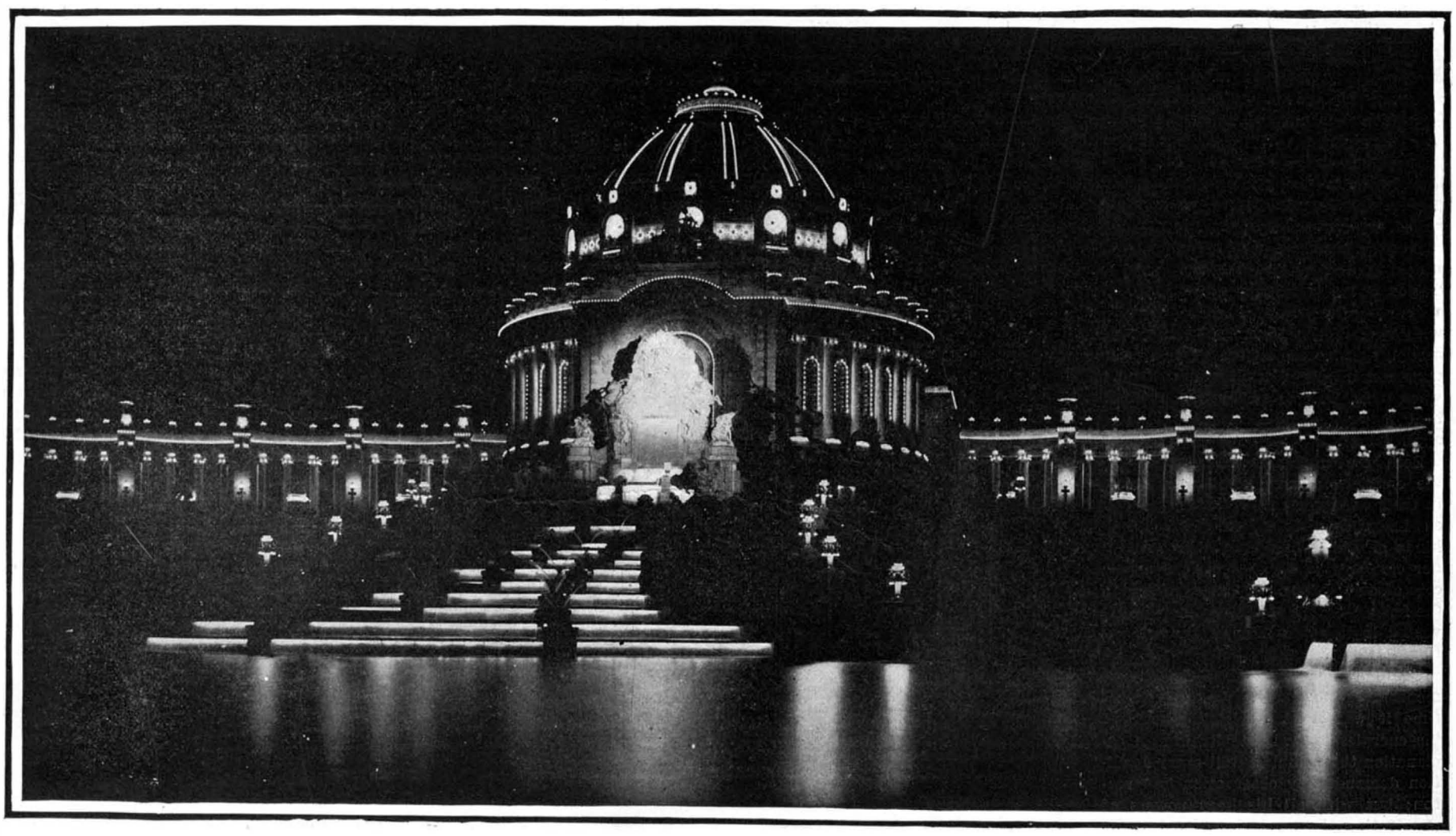
To enable our readers to preserve a memento of this scene, we present the accompanying double-page insert of what is certainly the finest scenic effect in the whole of the St. Louis Exposition.

Equally beautiful in its way is the night effect produced by the electric illumination of the Cascades and surrounding buildings; and that the crowds at the fair appreciate the illumination is proved by the fact that at the appointed hour for the display, which is set to take place in the last glow of twilight, vast throngs may be seen pouring through the many plazas to the great Court of Honor, from which the illumination may be seen to the best effect. The thousands of incandescent lamps are brought up gradually to their full brilliance, brightening from a dull red to an almost dazzling white. At intervals the lights on Festival Hall and the Colonnade are changed from white to pale green, and then to a ruby red. It is a picture that once seen will never be forgotten.



Engine and Tender weigh 163 tons. The turntable is 70 feet long by 5 feet deep.

EXPRESS ENGINE AND TURNTABLE IN OPERATION IN THE TRANSPORTATION BUILDING, ST. LOUIS WORLD'S FAIR.



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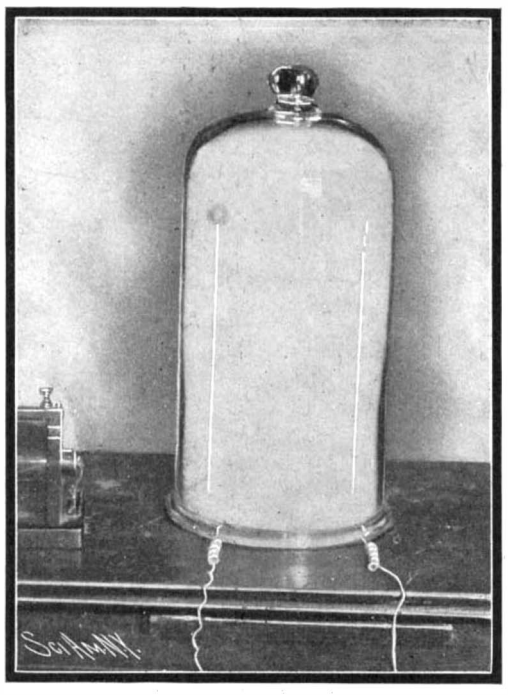
FESTIVAL HALL AND THE CASCADES BY NIGHT.

DISPELLING FOG BY ELECTRICITY—AN EXPERIMENTAL PROOF.

BY A. FREDERICK COLLINS.

A series of remarkable experiments have just been concluded by Sir Oliver Lodge, the eminent English physicist, who has been able to demonsrate by an ingenious method of his own devising that smoke, fumes, and fog may be dissipated by electrification.

The most recent trials have been conducted on a



Sir Oliver Lodge's Experiment in the Dispersion of Fog by Electricity, Conducted with a Bell Jar Filled with Artificial Fog.

scale approximating that which would be required in practice, and by means of apparatus to be described, Sir Oliver succeeded in clearing the air of a dense fog lying within a radius of 150 to 250 yards by the aerial wire used to project the electrical energy into the surrounding atmosphere.

While these very interesting successes in a new art, destined to become of commercial importance, are unprecedented in scope and character, still there is a history back of them which clearly indicates that great discoveries do not come with a single bound.

The first recorded experiment tending toward the solution of the dispersion of fog, smoke, and fumes was made by Tyndall in 1870. He found that when air laden with dust came in contact with a hot body, a space was instantly cleared of the foreign particles. This phenomenon can easily be reproduced by permitting a ray of sunlight to penetrate an otherwise darkened room immediately after sweeping or dusting, when each particle of dust may be clearly seen; if a candle or hot poker is held beneath the concentrated beam of light the dust is instantly dispersed.

It must not be inferred that the dust-free space is in this case very large; on the contrary it is confined to a very limited area. That there is anything mysterious in this apparently simple process, the veriest tyro in physics will deny. Yet Tyndall found the phenomenon sufficiently perplexing to give his best thought to it. As a result, he devised an ingenious mechanical hypothesis to account for it. Briefly stated, he assumed that the air was forced upward in convection currents faster than the suspended dust, which in consequence was left behind. As an illustration of the complexity of the problem a contemporaneous English worker with Tyndall, Dr. Frankland, next suggested that much of the visible dust consisted merely of moisture, and that when this was dried by the applied heat it was rendered invisible by the applied heat.

Both the novice in philosophy and the eminent investigators were wrong in their deductions as to the cause; for, as Lodge has since pointed out, all kinds of dust which is neither volatile nor combustible undergo the same process of elimination. In accordance with the facts, then, a new theory must be invented logically to account for this action.

Ten years elapsed before the experiments of Tyndall were repeated. This time it was Lord Rayleigh who bent his energies toward establishing an explanation that should fulfill every condition demanded by observation and reason; but with all his keen powers of penetrating the mysteries of nature he could not devise a satisfactory theory. Lord Rayleigh did, however, add a strikingly original experiment to those previously made by substituting a lump of ice which he held *over* the dust-laden air for the hot poker held *under* the suspended particles, as in the test of Tyndall.

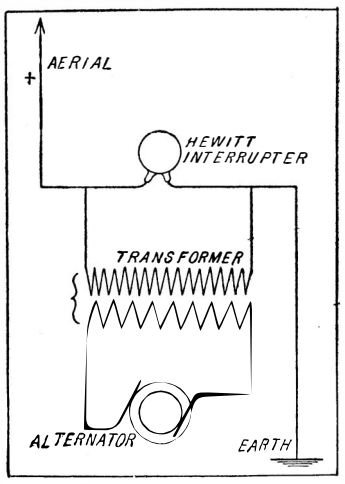
The result was surprising. The temperature of the ice caused a dust-free space to be formed, the dark plane of which was bordered by bright fringes of dusty air of great sharpness. Here the experiments rested until 1883, when Lodge, with a co-worker, Prof. Clark, repeated all the tests in order to ascertain the why and wherefore of the phenomena presented, if possible.

Numerous trials were made which disproved Lord Rayleigh's suggestion that the dispersion of dust might be due to the curvature of stream lines and centrifugal force. These abstruse explanations need not be considered here, for, however interesting, they were speedily shown to be fallacious. Suffice it to say that in the final analysis of the physicists, Lodge and Clark, it was determined that there emanated from the hot or cold body a molecular bombardment which drove the dust away from it.

This theory was good as far as it went, but then, in logical sequence, another question of greater import immediately arose as to what caused, primarily, the bombardment of the particles. It was suspected that the cause might be, and most likely was, of electrical origin.

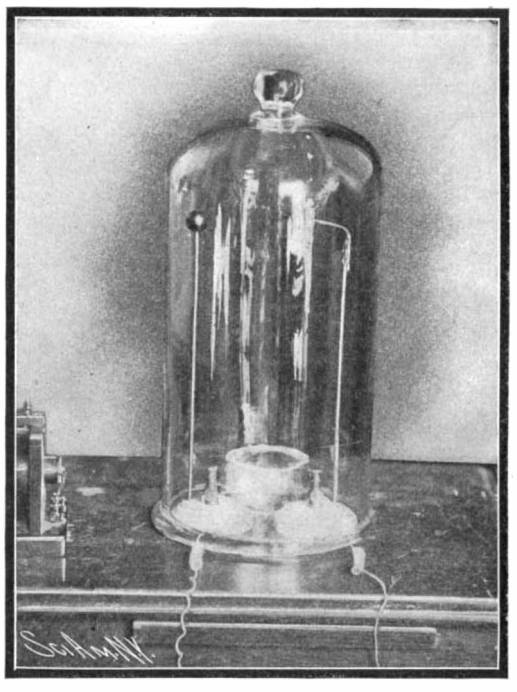
If to electricity was really due the origin of the dust-free space, the experimenters readily saw how it was possible that the air in streaming over a body of a different temperature than the air in which it was immersed might be electrified and the dust in consequence expelled. The experiment was tried; a rod was charged with electricity to several hundred volts, when a barely noticeable effect was observed. When the rod was positively electrified the particles were repelled, showing a slight extension of the dust-free coat, while a negative charge of the same potential produced a contraction of the plane to a slight degree.

By connecting the terminals of an electric machine to metal points in a box and filling the latter with smoke instead of dust, the experiment was repeated.



Electrical Connections of the Fog Dispersing Apparatus.

The voltage of the electric charge was enormously increased, so that a brush discharge resulted, when an extraordinary action took place within the confines of the box. The smoke was rapidly dissipated, rapidly clearing the entire box of smoke. The brush discharge referred to is a faintly luminous discharge from a pointed or small rounded positive conductor of an electrical machine or an induction coil and is sometimes called a connective discharge. The brush is caused by the accumulation of electricity forming a high potential charge of so great a density that it electrifies the neighboring particles of air which, driven by electric repulsions, fly off carrying part of the discharge with them. This fundamental experiment of discharging smoke by electricity was repeated again and again by Lodge and Clark, who filled the box with all kinds of smoke, such as tobacco, camphor, turpentine, magnesia, brown paper, steam, lead and zinc fumes, and the volatilized products of combustion of many other compounds as well as the fumes of metallic substances and aqueous vapors.



Bell Jar One Minute After the Experiment, Showing Its Freedom from Vapor.

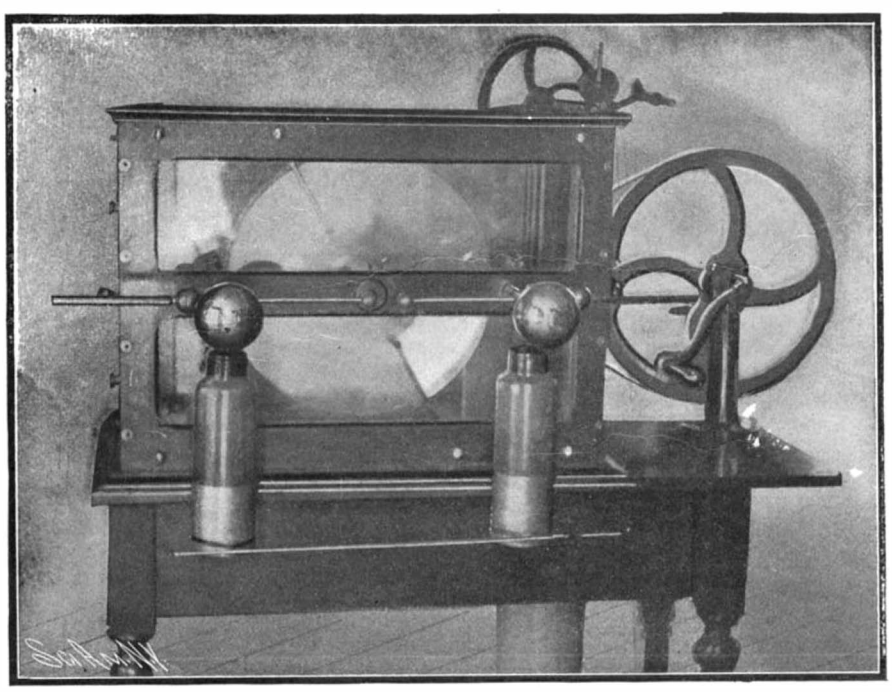
Whatever the nature of the exhalations might be when the electric energy from a high-tension machine was discharged into it the dispersion of smoke or mist was quickly effected. Better to observe the action of electricity on foreign particles held in suspension in air a bell-jar was employed. In some cases the negative pole was connected either with the ground or with a disk of metal in the bottom of the bell-jar containing the smoke, in others a double set of points was employed, each of which was connected to the opposite poles of the machine.

A number of striking results were obtained by varying the substances used for vaporizing and the arrangement of the discharge points; for instance, when inorganic dust, such as finely-powdered magnesia, was charged electrically the particles assumed a positive and negative polarity which attracted each other until minute balls were formed when they were projected against the sides of the glass jar with considerable force.

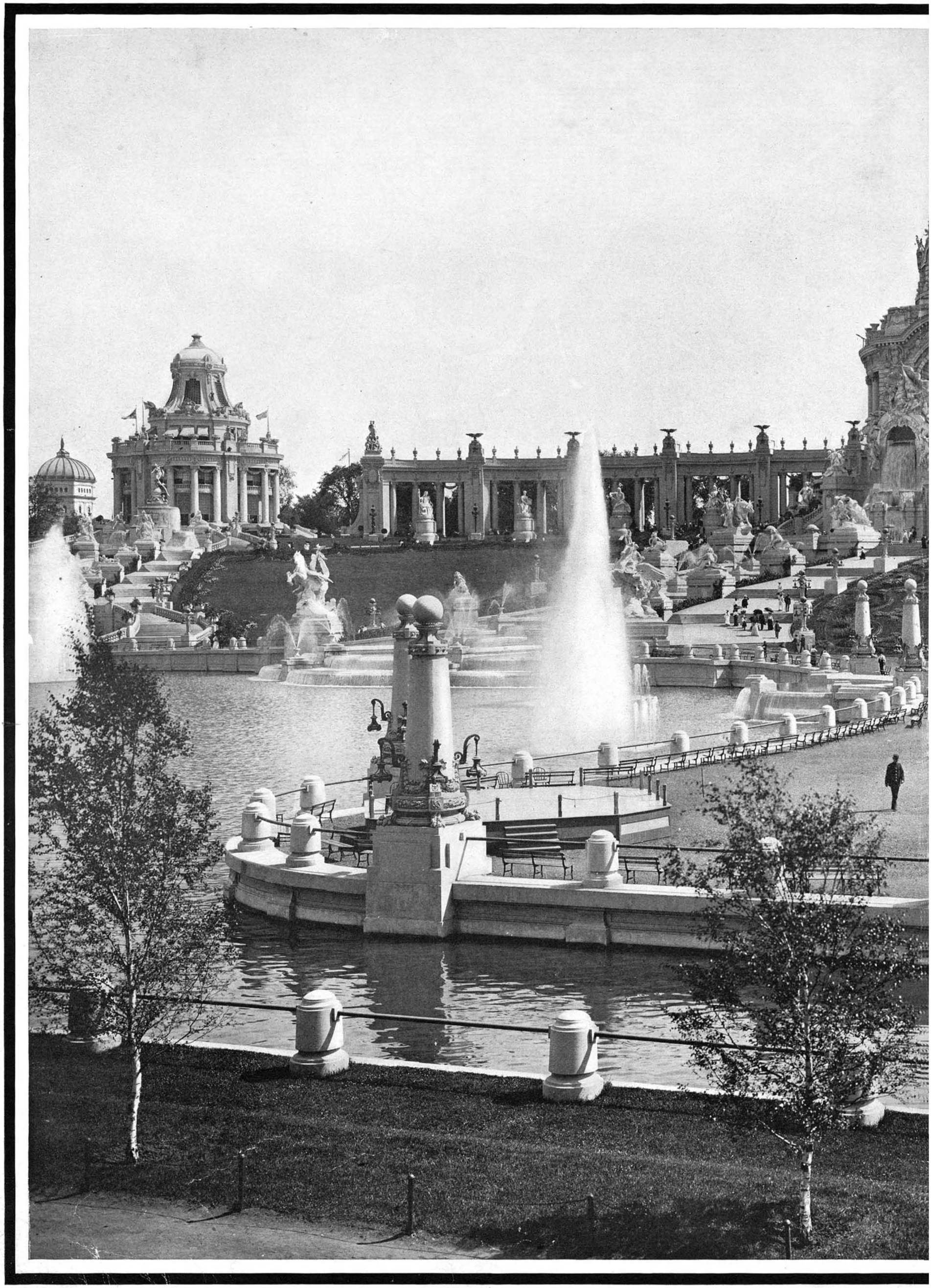
Again, when a pair of knobs were employed to electrify the air the lines of force acting on the dust particles were clearly defined. Sir Oliver attributes the cause of this remarkable action to electrified or polarized particles attracting each other just as iron filings are attracted by the inductive effects of a magnet. An experiment made by Lord Rayleigh on the electrification of water jets seems to verify this theory. He found that when a stream of water from a vertical water jet having a small opening is projected into the air it falls in exceedingly minute drops, forming what is called spray. If a stick of sealing wax or a glass rod is electrified by brisk rubbing and either of these is then held in close proximity to the place at which the jet of water breaks into drops the misty particles will be attracted to one another, until large drops resembling those of a thunder shower are formed.

From these facts Lodge concluded that clouds could be likewise converted into rain by the process of discharging electricity into them; indeed he demonstrated it by electrifying a cloud of steam in a bell-jar when the opaque vapor was rapidly changed into a fine rain resembling Scotch mist, when it was precipitated to the bottom of the jar and so disappeared.

Leaving the fascinating subject of rain-making for another time and returning to the subject proper, it should be stated that all the foregoing experiments were made some years ago. Recently, however, Sir Oliver concluded to make a practical test of the dispersion of fog by electricity. To



STATIC ELECTRIC MACHINE USED IN EXPERIMENTALLY DISPELLING FOG BY ELECTRICITY.



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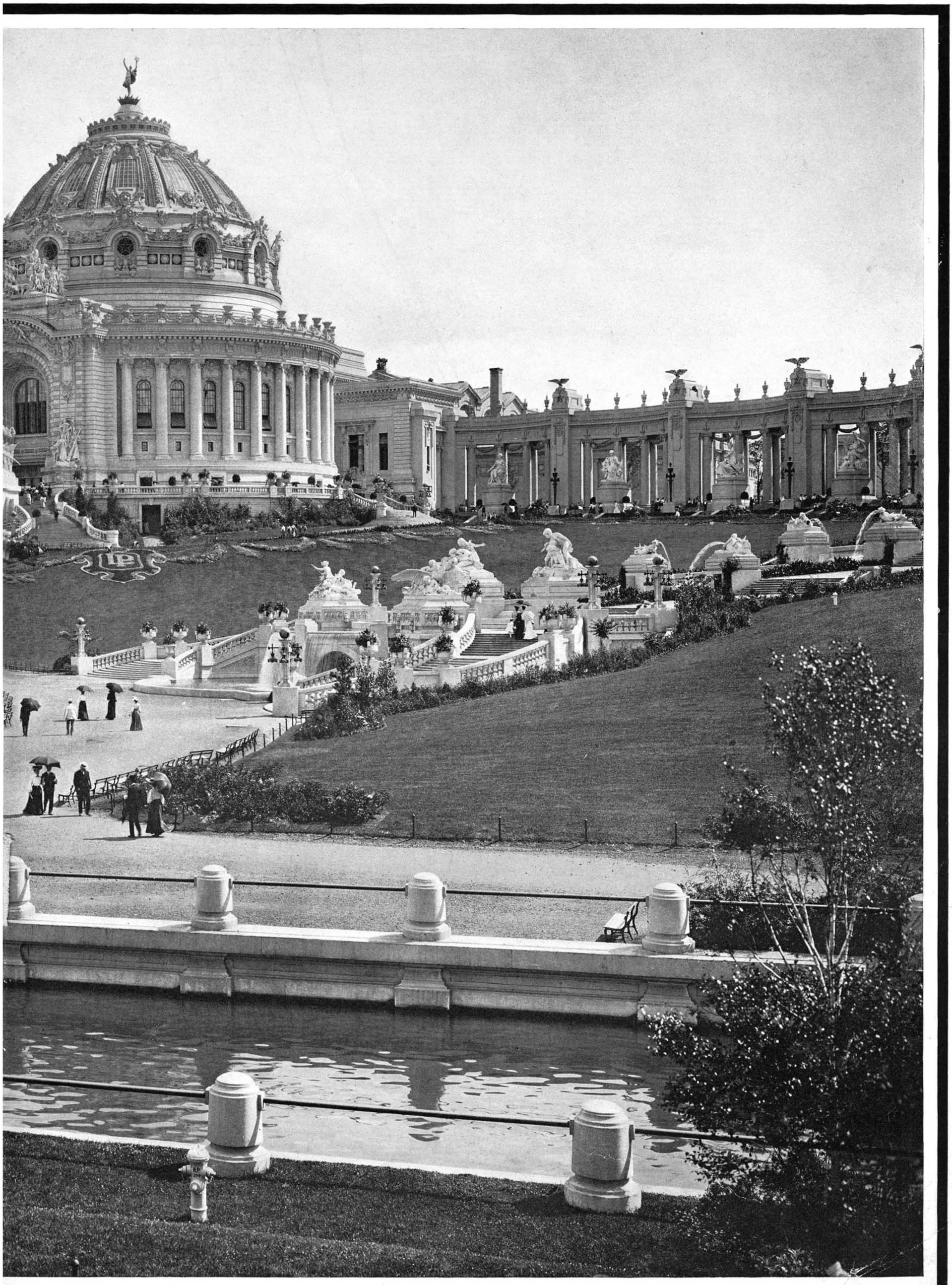
THE FESTIVAL HALL AND COLONNADE OF OF THE LOUISIANA



STATES---THE ARCHITECTURAL MASTERPIECE PURCHASE EXPOSITION.

accomplish this task an insulated wire was led from the laboratory of the university, Birmingham, England, to a flag-staff on the roof; the wire terminated in a number of fine points and as widely separated as possible. The base of the wire was connected to the positive pole of a high-tension electric machine.

The opposite or complementary pole was laid to the earth, the system resembling very much a sending station for wireless telegraphy, except that the spark-gap was not utilized, since this would have set up oscillatory currents, whereas the desired object was to keep the wire constantly charged with positive electricity.

When the dense fog had enveloped the building with a cloak so thick that the eye could scarcely penetrate it for more than a foot or two the professor and his associates mounted the roof while an assistant was left in charge of the high-tension generator.

When the signal was given and the machine had attained its maximum working velocity, the electrical energy was literally poured from the elevated points into the surrounding fog. The result was as gratifying as it was remarkable, for the fog cleared away in the immediate vicinity of the points leaving a space absolutely clear.

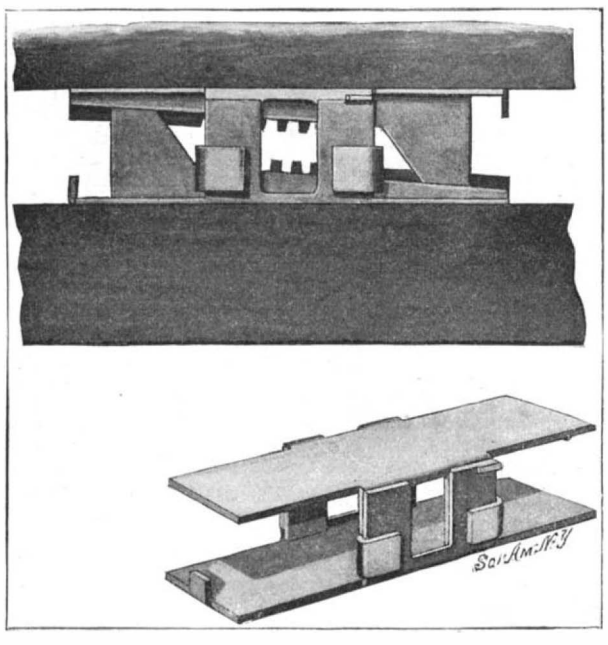
To put into effective operation this scheme of defogging the atmosphere, Sir Oliver proposed that stations be erected on either side of the River Mersey where as a result of much fog there are many collisions. Static electric machines, while giving the requisite high voltage, do not give a sufficient amperage, and the energy from induction coils is also too limited.

To overcome these objections Lodge proposes the use of an alternating current generator, and raising its voltage to the proper potential by means of a transformer; to the terminals of the latter a Cooper Hewitt mercury vapor interrupter is interposed and from the electrodes of the latter connectors lead to the aerial and earthed wires.

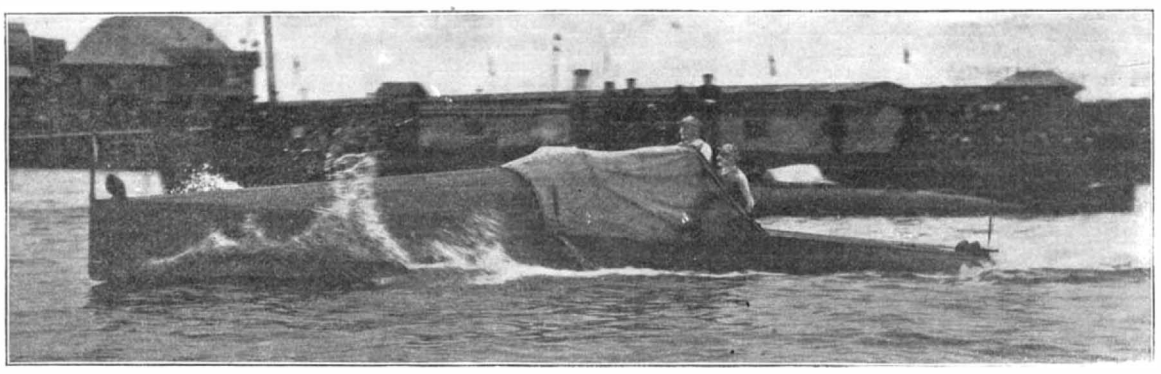
Such an apparatus could be installed with profit along the North and East rivers in New York city, and it would require but little energy to clear the Chicago River of fog, besides other places innumerable. Vessels could use the apparatus with telling effect and by its means many of the disastrous collisions could be averted.

QUOIN FOR LOCKING TYPE FORMS.

A patent has just been granted to Mr. William V. Crockett, of Corsicana, Tex., on an improved quoin for locking type forms. The quoin differs from the ordinary in being provided with bearing plates, which are so connected that by a sliding movement of the wedges the plates will be spread apart without lengthwise movement. This arrangement, it will be evident, prevents any movement of the type, as sometimes happens, when the wedges engage directly therewith. The accompanying illustration shows the quoin in position, and also shows a perspective view of the bearing plates. The wedges, it will be observed, are each formed with a heel portion, the heel portion of one wedge having sliding engagement with the inclined surface of the other wedge. To prevent lateral movement of the wedges, one relatively to the other, the heel portion of each wedge is provided with a channel to receive a rib on the inclined portion of the other wedge. On their inclined or adjacent surfaces the wedges are provided with teeth designed to be engaged by a suitable tool so as to facilitate moving the wedges lengthwise in opposite directions. The tool may consist of a key having teeth formed on its shank. The bearing plates are formed with interlocking side pieces, so arranged as to permit only a limited sliding movement of one plate with the other. To limit the outward movement of the wedges with relation to the plate, the latter are provided at opposite ends with lugs. In operation, after placing the form in the chase, the quoin is placed therein in the usual manner, then the wedges are operated by the tool to cause the bearing plates to spread apart and thus clamp the type.



QUOIN FOR LOCKING TYPE FORMS.



"NAPIER II.," A CONTESTANT IN THE INTERNATIONAL MOTOR BOAT RACE. SPEED, 20 KNOTS AN HOUR.

The towing tests of full-sized models on the results of which this boat was patterned were illustrated in our issue of May 21.

THE INTERNATIONAL MOTOR-BOAT CONTEST. "NAPIER II."

A short time ago we described in the SCIENTIFIC AMERICAN a series of experiments that had been carried out by Messrs. Yarrow & Co., of Poplar, London, to determine the best form of hull for high-speed motor boats, and we illustrated the type of craft which caused the least disturbance of water when traveling at high speed.

The Yarrow-Napier launch herewith illustrated, which was built to compete for the International Cup in England, is built upon the results achieved from those trials. It measures 40 feet over all, 40 feet water line, and has a beam of 5 feet. The hull is constructed throughout of steel. The boat has a straight sheer line falling from the stem to the stern. There is an ample turtle deck forward and a nearly flat deck aft. The tumble-home top sides aft and the substantial wall-sided bow give an impression of stability and speed. The decks are of steel and the rudder and "A" brackets are steel forgings. The two gasoline motors, which are of the Napier machine racing type, develop 90 horse-power. They are carried on a substantial girder run fore and aft of the boat and are also attached to the side of the craft on special frames. Thus the boat and motor are absolutely tied together, and experience has demonstrated that this method of securing motors and thrust block is quite satisfactory.

The reverse gear for the starboard engine—the boat is fitted with twin screws—and the thrust bearings of both engines are in metal box-shaped castings, also secured to the motor girders. These boxes are filled with oil, and being quite watertight enable the bearings, especially the thrust bearing, to run entirely submerged in oil. The engines are connected to the shaft by Napier metal-to-metal marine clutches, which run in oil and are operated by pedals actuated by the steersman, thus placing the boat under his complete control.

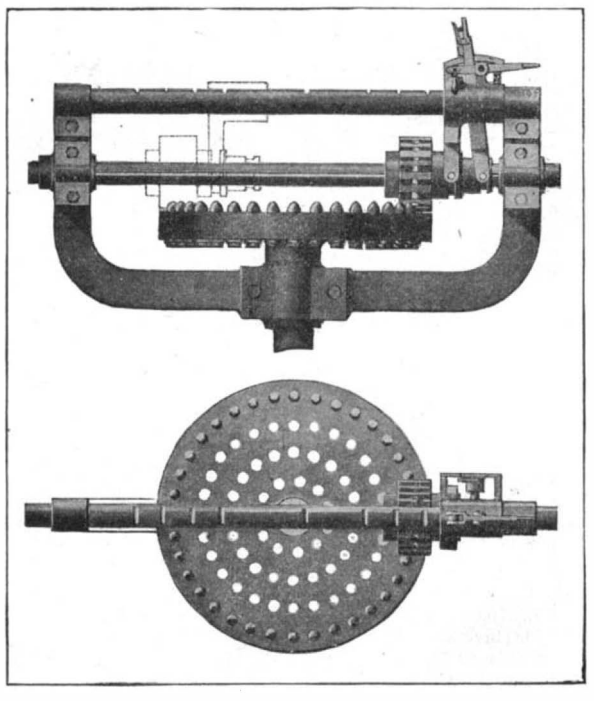
The exhaust of the Napier water-jacketed exhaust system, and the exhaust receivers and pipes are kept quite cool throughout their entire length. The water circulation is accomplished by two pumps for each motor, which by means of transfer pipes and cocks can be connected together. In the event of one circuit breaking down one pump serves to supply the water jacket of the engine, and the other supplies the water-jacketed exhaust. In addition to these pumps auxiliary hand-pumps are fitted which can be immediately brought into play when required. The gasoline reservoir is also water jacketed and is carried aft, with the direct supply tank for the motors placed forward. The gasoline is pumped up from the reservoir to the supply tank by means of a hand pump, and the overflow simply runs back again into the store tank, and indicates when it is doing so in a gage. The lubrication is triplecate, drip feed, splash and forced lubrication being in operation simultaneously. All bearings thus have three distinct methods of oil supply. The lubricant is carried in a store tank and is pumped by hand to feed whatever part is required through pipes leading from a distributer.

The steering acts directly from the wheel to the rudder quadrant without any intermediate pulleys or turns in the wire. This produces practically the same result as tiller steering and is extremely sensitive in operation. Attached to the engine is an instrument board to which all regulators and so forth are brought, so that everything is immediately before the engineer, and he can manipulate the two engines to a nicety and steer the boat if necessary by the two screws, should the rudder become deranged. A new system of automatic bilge ejection has been adopted which is capable of dealing with vast quantities of water with very little expenditure of power and which is quite automatic in its action. The engines are fitted with high-tension synchronized ignition, accumulators, and coil, and the motors are started by the simple operation of a switch. Either engine can be started by the other.

For the International Cup race off Cowes there were 9 boats entered, of which 5 were British, 3 French, and 1, the "Challenger," was from the United States. In the preliminary trials two boats, "Napier II." and "Napier Minor," proved to be superior to their British competitors, and although "Napier II." at times showed better speed than "Napier Minor," the latter was selected to meet the French boat "Trèfle-a-quatre" in the final, which she won. She covered the 7.8 miles course in 23m. 3s. as against a time of 24m. 27s. for the French boat, the winner's speed being about 20 knots an hour. The prize, however, went to the French boat on a technical protest.

IMPROVED VARIABLE SPEED AND REVERSING GEAR.

In the accompanying illustration we show an improved form of variable speed and reversing gear, invented by Mr. John Busche, of 17 Brown Avenue, Turtle Creek, Pa. The gear will permit the convenient reversing of the motion and varying of the speed, both forward and backward, without requiring stopping of the driving member. The driving member consists of a disk on the power shaft, with its upper face studded with pins. The pins are arranged in concentric circles, and are secured to the disk by means of tapered shanks, which enter tapered openings and are held in place by split rings engaging grooves in the shanks at the under side of the disk. The driven pinion is mounted to turn with and slide lengthwise on a shaft running at right angles to the power shaft. The pinion comprises a hub adapted to slide within a body portion which carries the teeth. The teeth are formed with inwardly-projecting tongues adapted to co-act with the inclined walls of an annular groove in the hub and thus be withdrawn within the pinion when the hub is moved lengthwise relatively to the body portion. A sleeve mounted to slide on a shaft lying above the pinion shaft is formed with a shifting-fork adapted to engage an annular groove in the body portion of the pinion. This sleeve is provided with a locking pin adapted to engage one of a series of notches in the shaft, and thus hold the pinion in engagement with the corresponding circle of pins in the driving wheel. The sleeve also carries a forked lever which engages an annular groove in the hub. When it is desired to vary the speed, the forked lever is operated to slide the hub within the body portion of the pinion, thus withdrawing the teeth within the pinion. The locking pin is then raised and the sleeve with the pinion is shifted to the desired notch on the shaft. The forked lever is now moved back to project the teeth which will then engage with the desired circle of pins. If the pinion is moved past the center of the wheel its direction of rotation will be changed.



IMPROVED VARIABLE SPEED AND REVERSING GEAR

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

BASE FOR ELECTRICAL FIXTURES.—L. Steinberger, New York, N. Y. The invention relates more particularly to an insulating-base used for switchboards and smal office-work instruments. The construction is such that the binding-posts and other metallic members mounted rigidly upon the base cannot be tampered with nor release the wire within the base. By certain means, a slot prevents the members from turning relatively to the insulation. Wires once in position means render the several parts practically integral and avoid defectiveness of contact within the base. The wire is wrapped around the members, follows contour of grooves, and bends downward into the slot whose depth enables it to engage a portion of the insulation notwithstanding the presence of the wire in the slot.

PRINTING-TELEGRAPH.—J. D. White, 50 Clanricarde Gardens, London, Eng. Mr. White's invention has for its object the provision of means for rotating the axle which carries the type-wheel or type-wheels or type-cylinder by electro-mechanical devices controlled by a few circuits, so that the opening and closing of these few circuits separately and in various combinations may be used to rotate the axle to many different degrees and to provide for the printing of many different characters.

CENTRAL ENERGY SYSTEM.—W. M. Kelly, and G. E. Truxell, Greensburg, Pa. The improvement of these inventors relates to telephony, their particular object being to produce a simple, reliable, and efficient system in which a power-circuit is automatically employed for energizing the individual ringing-circuits and in which an improved contact-box is connected with each individual switch-hook.

Of Interest to Farmers.

AUTOMOBILE PLOW.—H. B. Burdick, Middleton, Oklahoma Ter. The purpose of this invention is to construct a form of plow in which the motive power is carried upon the frame of the plow and is suitably connected with the bull or driving wheel and to provide means readily accessible to the operator for steering the machine, adjusting it for hillside work, and regulating the depth to which the plow shall enter the ground.

Of General Interest.

FISHING-GEAR.—A. W. Wilson, San Francisco, Cal. This invention relates particularly to that class of fishing devices in which a spoon is connected with the hook and the latter adapted to be trolled through the water, so that the spoon attracts fish, causing the fish to take the hook. In a prior patent granted to Mr. Wilson, a device of this general character is disclosed. The present object is to avoid possible derangement of the spoon with respect to the link and swivel, which end is attained by the construction of the link.

APPARATUS FOR FILLING CASKS OR LIKE VESSELS WITH LIQUIDS.—A. B. Von Echt, Vienna, Austria-Hungary. This apparatus consists of a system of filling-pipes which extends from the tank or rather receptacle in the usual way, but is stationary and is provided with a common shut-off device, and also of a lifting arrangement for the cask which for the purpose of enabling it to be filled with the liquid under consideration is raised and pressed tightly against the shut-off device by the lifting arrangement, and finally, of an abutment against which the filled cask is pressed by the same lifting arrangement for the purpose of pressing in the bung.

DRILL CHUCK.—C. W. Sargent, Murray, Idaho. In this patent the invention relates, more definitely stated, to chucks for rock-drills; and it consists in a chuck of the character stated having means for securing the bit in the chuck-socket. The improvement is equally adapted to tool-handles in general, having a socket for receiving the shank end of any tool adapted thereto.

ROLLER-SCREEN.—F. M. Spiegle, New York, N. Y. The object of the invention is to provide a screen for use on windows, piazzas, and other places desirable to be screened against flies, mosquitos, and other insects and arranged to permit convenient and easy unrolling of the screen for screening purposes, to allow rolling the screen up to be completely out of the way when not in use, and to prevent bulging when in use.

SUPPORT FOR SOUND RECORDS OR BLANKS.—L. Steinberger, New York, N. Y. This invention relates to supports for sound records or blanks, and admits of general use, but is intended more particularly for records having cylindrical or substantially cylindrical form. By using Mr. Steinberger's support or holder the record is practically rendered so durable that it may be thrown over with considerable force and yet without injuring the delicate blank or record portion or marring the record-surface thereof.

COOLER.—H. Reininger, New Orleans, La. The object of this invention is to provide a cooler for cooling wort, beer, and other liquids and arranged to increase the cooling efficiency of the cooling medium, to allow convenient and thorough cleaning of the various parts, to reduce the loss of the liquid to a minimum, and to prevent the liquid from coming in contact with the atmosphere during the cooling process.

PROCESS OF SEPARATING FLUID PORTIONS FROM SOLID PORTIONS OF FATTY SUBSTANCES.—W. B. Kerr, Medford, Mass. In this case the invention relates to a process for separating oily fluid portions from the comparatively solid portions of fatty substances, such as tallow, lard, etc. Mr. Kerr has made the discovery that a solution of papain, a substance made from the papaw-tree and having properties analogous to those of pepsin, is very useful when employed in a process for carrying out this purpose.

BREECH-LOADING FIREARM.—A. Chuchu, Bahia, Brazil. The purpose of the inventor is to simplify and improve the breech-loading firearm for which a patent had previously been granted him, the construction being such that the pivoted breech-block is provided only with a spring-controlled hammer, a sear for the hammer, a firing-pin and a lever-controlled cam for cocking the hammer and holding it locked in cocked position until purposely released, reducing the construction of the frame and block to such few parts as to render possible the arm's repair by any person of ordinary intelligence, in short time and on the field if necessary.

DEVICE FOR HOLDING CANDLES.—E. W. Curtiss, Baker City, Ore. The improvement has for its principal object to overcome numerous disadvantages attending the use of other devices hitherto devised, and to provide a device which is simple in construction, inexpensive to manufacture and possessing the capacity for long and repeated service. It is admirably suited for the purposes of miners when at work in mines, as well as to others.

WRENCH.—E. K. Ansorge, Greenbay, Wis. In this instance the invention relates to a wrench of that class in which the nut-socket is in the form of a ratchet and the body of the wrench carries a dog coacting with the ratchet, so that a step-by-step movement in one direction may be given to the nut through an oscillating movement of the wrench handle. The improvement resides particularly in the novel form of the dog.

BUCKLE.—L. Sanders, New York, N. Y. The purpose in this case is to provide a buckle especially adapted for use in connection with suspender-straps or cartridge-belts, but which may be used wherever a positively-locking tongueless belt can be advantageously employed, and to so construct the buckle that it will be light and readily applied and when applied whereby the strap passed through the buckle can be quickly and conveniently adjusted and held in adjusted position without applying eyelets to the straps or producing apertures therein.

CORSET ATTACHMENT.—E. J. Montigny, New York, N. Y. In this patent the invention relates to improvements in corset attachments in the nature of a pad or compressor designed to reduce the abdomen of the wearer, an object being to provide a device of this character so constructed as to be readily attached to corsets and as easily detached therefrom when not required for use.

LIFTING-JACK.—J. C. Houston, Yazoo City, Miss. More particularly this invention relates to jacks such as are employed for raising a vehicle-axle to permit the removal and replacing of one or both wheels to permit lubrication or repair of the wheels, and has for its object to provide details of construction for a jack which are simple, practical, and inexpensive and that afford a light, powerful jack that may be used to raise one or both ends of the axle engaged therewith.

TRAINING-MACHINE.—C. L. Hagen, New York, N. Y. This invention relates to a machine for facilitating the athletic exercises or training of men and animals. It is preferably applied to a machine for men, although it may be used with equal advantage for the training and exhibition of animals. Its general characteristic is a frame and an endless apron which is held on rollers in the frame, said apron moving under the feet of the person using the machine.

BURNER AND MIXER FOR CAUTERY.—J. P. Müller, New York, N. Y. The object of the invention is to provide a burner and mixer for cautery and arranged to provide a burner for the initial exterior heating of the cauterizing-tool and a mixing-chamber having the same source of gas-supply as the burner and arranged to permit minute regulation of the amount of gas and air required to furnish a proper mixture to be burned in the cauterizing-tool.

ROCK-DRILL GUIDE.—H. F. Huntington, Salmon, Idaho. In this instance the invention refers to improvements in guides for rock-drills, an object being to provide a guide with a simple means for adjusting to compensate for wear and to prevent lateral play of the drill in the guide, thus causing the drill to work true and prolong the usefulness of the guide, which ordinarily wears out rapidly.

METER.—J. H. Connell, Charleston, West Va. Mr. Connell's invention is an improvement in meters for measuring water and other liquids, and has for an object to provide a novel construction of meter which can be easily assembled and taken apart for repairs or for any other purpose and which will operate efficiently without appreciable diminution in the pressure of the water.

EMERGENCY FIRE-SCREEN.—W. M. Conran, Marshalltown, Iowa. Presuming that the wall carrying the proscenium-arch is of fireproof construction, Mr. Conran's invention is intended to protect the proscenium-opening of a stage and to effectually and instantaneously eliminate the danger of fire passing from the stage to the auditorium, and it is also designed to prevent or modify the effect of gases reaching the audience in the case of an explosion on the stage.

COPY-HOLDER.—A. R. Dearborn, Birmingham, Ala. The invention relates to a device intended especially for use in connection with typewriter cabinets to hold the copy in position to be conveniently read by the operator. It involves certain novel features of construction with respect to the copy-holder *per se* and novel features of arrangement relatively to the typewriter table and cabinet.

GOLD-LEAF CONDENSER.—J. D. Ford, Somerset, Ohio. This improvement is in the nature of a condenser for the goldfoil used in fillings. The condenser comprises two sections slidable relatively to each other and provided with opposing shoulders and means for varying the exposed or operating surface of one of the shoulders, whereby it may be conformed to the extent of the opposing shoulder and in the construction Dr. Ford arranges for operating the means for varying the operating surface of one shoulder by the other.

REINFORCE.—J. F. Francia, 9 Rue Leonard de Vinci, Paris, France. This invention relates to masts, spars, ladders, fishing-rods, oars, and other breakable articles. The features are increased strength; whatever small additional weight is added by the thin steel strips, bindings, etc., is counterbalanced by the safe use of the very lightest woods, such as poplar; the strips being tempered thoroughly and evenly in the coil are much stronger than their equivalent weight in steel tube form; the modes of action can be compared to ship masts stays, with the advantage that they are independent, these "stays" being fixed to the pole ends themselves; and they offer enormous resistance at all sides at once the moment the strain begins.

ATTACHMENT FOR CORSETS.—M. H. Gerstle, New York, N. Y. The invention pertains to combined garment-supporters and skirt-retainers, and provides a plate having a shank of special construction by which to enable the same to be detachably connected with one of the fastening-studs of an ordinary corset-front, the shank being of further special construction for adjustable connection therewith of a retaining device for the waistband of one or more skirts, the entire structure being exceedingly light in weight and capable of being worn without inconvenience and discomfort.

PACKAGE-CARRIER.—T. Harris and O. E. Schobert, West Pittston, Pa. In this instance the invention refers to improvements in devices for carrying packages, particularly boxes containing dynamite for use in mines, the object being to provide a carrier readily adjustable to the size of load or number of boxes placed in the carrier, thus preventing the shaking about of the dynamite, and consequently preventing accident when lowering the device in a mine. It is compactly foldable when not in use.

LIFTING-JACK.—L. E. Hocker, Montevista, Col. The object of this improvement is to provide a novel construction which will be simple, durable, inexpensive, free from complication, and easily operated and which can be stopped in any desired position to support the load. Mr. Hocker's device can be used for light or heavy lifting and can be easily operated in either instance.

HOSE-COUPLING.—W. S. Jewell, Oakland, Cal. This coupling is applicable to all kinds of hose, tubes, or pipes, to which it can be applied for the purpose of coupling the same either to a nozzle or for coupling two sections of hose or for connecting hose to a stationary inlet or outlet pipe or for mending a section, the object being to provide a device which shall do away with wiring, washers, screw-threaded and expensive and complicated parts, as well as special tools used for such purposes, and which shall secure great saving of time, especially in mending or coupling in case of a fire.

COLORING-MATTER AND METHOD OF PRODUCING SAME.—G. J. Kaufmann, New York, N. Y. The invention relates to mineral paints; and its object is to provide a coloring-matter and method for producing the same, the matter being an equivalent of both raw and burnt terra di sienna and on being mixed with oil, water, or other liquid readily forms a paint for immediate use in graining and staining without any addition of burnt umber, Van Dyke brown, or the like for the painting of houses, etc., for calcimining and tinting or for use as a substitute for ocher.

DETONATING-ALARM FIRE-EXTINGUISHER.—M. A. Libbey, South Berwick, Me. In this patent the invention relates to a combined detonating alarm and fire-extinguisher in which the inventor seeks to produce a construction wherein the loud report or noise following the ignition of a charge of high explosive serves to give an alarm of fire, while the bursting energy of the charge fractures an extinguishing-fluid container and scatters it over a wide area in the vicinity of a blaze.

SHOE-LACE.—C. B. Isakson, New York, N. Y. In this patent the invention has for its object the provision of a new and improved shoe-lace arranged to permit of quickly lacing and unlacing a shoe and for holding the lace securely in place on the eyelets, studs, or other lace-retainers of the shoe when the latter is laced up.

CLOSURE FOR BOTTLES OR OTHER RECEPTACLES.—C. M. Young, San Francisco, Cal. The object of Mr. Young's invention is to provide novel details of construction for a bottle or jar closure which will infallibly show when the contents of the receptacle have been partially or entirely removed, this being exposed by the retention within the bottle of a sealing-plug that is an important detail of the improved bottle or jar closure.

Hardware.

WELL-POINT.—W. Patterson, Central City, Neb. The principal objects of the invention are to increase the strength of the strainer part, to so arrange the parts that the screen may be easily reached for repair or renewal, and to obtain a free flow of water through the point. The inventor in attaining these ends wraps one or a plurality of layers of screen spirally around the inner perforated tube, thus getting far greater strength than attained when the screen is put on square, and he forms the outer perforated tube in two or more longitudinal sections removably fastened in place, thus readily reaching the screen for repairs, etc.

PIPE-WRENCH.—L. H. Plank and A. C. Plank, Rochester, Minn. This invention has reference to improvements in wrenches, and has for its object the provision of means novel in character whereby the tool is rendered not only quick in action to improved degree over all similar devices known to use, but in being adapted for adjustment and more effective gripping of the pipe.

NUT-LOCK.—W. H. Burnett, Springfield, Ill. The improvement relates to nut-locks of a class in which the nut is held in locked condition on the thread of the bolt by means carried by the nut and adapted for interlocking engagement with a groove in the bolt, and has for its object to provide construction for a lock which adapts it for convenient adjustment either to lock the nut at a desired point on the threaded body of the bolt or release the nut to permit its removal from the bolt without injury to the nut, bolt, or locking device.

DRILL.—F. Russell and R. P. Russell, Cripplecreek, Col. The objects of the invention are to provide for the carrying of the cuttings out of the hole and to prevent crookedness in the holes drilled. In operation the drill has about a six-inch stroke, which throws the cuttings back to the shoulders, which keep passing them on out of the hole. The sharp shoulders on the shanks of the drill cut out the sides of the hole if it starts to get crooked or fitchered.

Household Utilities.

REFRIGERATOR.—F. W. Wheldon, New York, N. Y. In Mr. Wheldon's patent the invention relates to improvements in refrigerators or ice-chests, an object being to provide a chest with a plurality of inner walls of textile material spaced apart to form air spaces, whereby there may be a free circulation of air, causing a low temperature and preserving the ice to a considerable extent, and this construction also makes the device comparatively light and inexpensive.

WINDOW-REFRIGERATOR.—H. C. McClung, New York, N. Y. In this instance the invention pertains to refrigerators, and more particularly to a device such as is suitable for attachment at a point adjacent to a window, the arrangement being such that the refrigerator may be drawn into the window for purposes of accessibility and may be thrown outwardly, so as to not impair the light coming in at the window.

CANDLE-EXTINGUISHER.—C. B. Isakson, New York, N. Y. The object of this improvement is to provide an automatic extinguisher which is simple and durable in construction, cheap to manufacture, easily applied to a candle at any point of its length, and arranged to automatically extinguish the candle after a predetermined length of the candle has been burned.

STOVE.—F. J. Ploch, Provo City, Utah. The object in this case is to provide a stove having a down-draft. In operation, a fire having been made in the fire-pot the gases of combustion pass over the end of the pot and immediately between stays, passing downward and circulating around ventilating pipes, heating them thoroughly. The gases next pass into the conical base and are thence drawn upward through a flue formed by partitions, an inner and an outer shell. The updraft-flue formed is entirely within the stove, being encircled by the outer shell. Air within ventilating-pipes being heated passes upward, and cold air is constantly drawn in the bottom ends of these pipes.

SCREEN-BED.—A. L. Gillis, Salem, Iowa. The purpose of the inventor is to provide a bed that will completely exclude flies, insects, reptiles, etc., and it is designed more especially for children. To this end he provides a bed which has its sides, ends, and bottom formed of screen material, the sides having hinged

sections adapted to fold toward each other to also form a screen top or roof for the bed.

Machines and Mechanical Devices.

COPYING-PRESS.—A. L. SNEED, Clarks, La. The object in view of this inventor is to produce a simple and compact structure wherein provision is made for the application of powerful pressure through a platen upon the work, the construction being such that very little effort is required on the part of the operator and the adjustment of the platen may be secured very quickly. It is more especially designed for press-copying letters, manuscripts, and the like.

HONEY-EXTRACTOR. C. W. METCALF, San Diego, Cal. This invention relates to improvements in machines for separating honey from the comb by centrifugal action, an object being to provide a machine for this purpose of simple construction and having a novel means for limiting the outward swing of the honey-carrying baskets.

FRICTION-BRAKE. G. A. ENSIGN, Defiance, Ohio. In this patent the object of the invention is the provision of a new and improved friction brake for use on shafts and other driven parts, to bring the said parts automatically and quickly to a standstill at the desired time. It is a division of the application for Letters Patent of the United States for a mortising machine, formerly filed by Mr. Ensign.

COTTON-GIN.—E. R. BARBER, Valdosta, Ga. This invention relates to a gin in which the seed-cotton is fed to a rotating drum having peculiarly-constructed teeth serving to take up the cotton and pass it to a rapidly-rotating beater, by which the seeds are removed, after which the gin passes it to specially-arranged rocking rollers having cards thereon, the cards of one roller acting to remove the lint cotton from the drum and the cards of the other acting to remove the cotton from the first roller and to discharge the cotton from the machine.

ROCK-DRILL.—F. L. WHITEHEAD, Butte, Mont. The invention has reference to improvements in drills of the type in which the drill is moved in its operating direction by hammer-blows; and one of the objects is to so construct the device as to utilize a portion of the driving force of the hammer to turn the drill and keep the cutting edge at a certain distance from the bottom of the hole.

THEATRICAL APPLIANCE. BELLE LA VERDE, New York, N. Y. The object of this invention is to provide a new and improved theatrical appliance for heightening the attractiveness of theatrical performances and which is designed for use on parts of the scenery on the stage, moving objects, etc., more especially, however, on the costumes of actors, dancers, and other persons appearing in spectacular plays.

ELEVATOR. E. C. NORTHRUP, San Jose, Cal. In this case the invention refers particularly to improvements in devices for elevating boxes of oranges or other fruit and dumping the fruit into a chute leading to a grader, an object being to provide an elevator so arranged as to be practically automatic in its operation of dumping the fruit and carrying off the empty boxes.

BORING-MACHINE. F. C. ZEEK, Muncie, Ind. The invention specifically appertains to a mechanism designed especially for use in boring holes in the joists of ceilings or floors for the passage of concealed electric wires. In carrying out the present invention Mr. Zeek has in view the provision of a mechanism embodying the essential features of durability and convenience, especially the latter, inasmuch as his machine may be placed so as to bore quickly and properly a plurality of openings or holes in joists spaced apart at varying distances.

GUARD BOARD.—J. L. GALLECIEZ, Deferiet, N. Y. In this patent the invention has reference to a guard-board for the couch-rolls of a paper making machine. The object of the improvement is to provide a guard-board which may be made to engage the couch-roll more uniformly than heretofore without, however, subjecting the roll to unnecessarily destructive pressure.

MACHINE FOR PRODUCING CRIMPED OR CORRUGATED METAL STRIPS.—W. P. GRAFTON, 82 Elliscombe road, Old Charlton, Kent, England. The mechanism closes together corrugations of a corrugated sheet or strip to bring the strip to the desired crimped form, the machine comprising pairs of rolls for corrugating, pairs of retarding rolls for closing the corrugations made by the corrugating rolls, pairs of propelment-rolls for forcing the strip against retarding rolls, pairs of accelerating-rolls for opening out previously-closed corrugations to extent required in final product, takers-off for the strip in passage, means for cutting strips into narrower strips before entering corrugating-rolls, and means for automatically severing portions of uniform length from final product as it passes from the machine.

ELEVATOR APPARATUS. J. B. HONOR, New Orleans, La. In this case the invention has reference to apparatus for elevating and transfering various materials, it being more particularly applicable to the coaling of vessels and the delivery of crushed rock and earth, and the improvement enables the transfer of material to be accomplished very expeditiously.

COFFEE DRIER.—E. PENAGOS, Bucaramanga, Colombia. This invention appertains particularly to an apparatus designed for drying coffee beans and the like. In this instance Mr. Penagos has particularly in view as an object the provision of an apparatus through which the coffee may be passed continuously and subjected to a number of heatings, thus insuring a thorough drying or curing of the beans.

ADDING-MACHINE.—R. CORBIN, Platts burg, N. Y. The invention relates to a construction of machine capable of being held in one hand and conveniently and readily operated by pencil or styles held in the other to add a column of figures and show correct aggregate or to effect reversal of mechanism, thereby, for example, restoring the various dials quickly and accurately to normal positions, at which time the zero on each of the dials will be presented to properly-disposed openings in the casing of the device, at which openings the numerals are likewise presented which indicate the sum of addition.

Pertaining to Vehicles.

RUNNER ATTACHMENT FOR VEHICLE WHEELS.—G. F. MEYER, Green Island, N. Y. In this instance the object is to produce a thoroughly practical device which is adapted for ready application to vehicle-wheels of different widths, which will not mar the wheel when applied thereto, and which is provided with means for securing it in position upon the wheel in such a way as to prevent any rattling of the attachment upon the wheel. The invention relates to runner attachments for wheels of the type in which a runner attachment is designed for application to each wheel to convert the vehicle into a sleigh.

SAFETY DEVICE FOR ELECTRICALLY-PROPELLED VEHICLES. J. H. SPENCER, New York, N. Y. The object in view of the inventor is to provide an improved safety device for such vehicles—as automobiles, trolley-cars, and the like, whereby the motor and the source of electricity are instantly disconnected in case of an accident to bring the motor, and consequently the vehicle, to a stop and insure the safety of the occupants.

SLED.—C. E. BURNHAM, Dekalb Junction, N. Y. Mr. Burnham's invention is an improvement in sleds, and particularly in that class of sleds ordinarily known as "bob-sleds." The opposite runners work entirely independently, and the beam may support the load on a level as desired. The construction is simple, can be cheaply made, easily applied, will be durable when applied, and can be repaired at slight cost if necessary.

HORSE-RELEASING DEVICE.—W. E. BOLSTA, Ortonville, Minn. This invention refers to a device for releasing horses or other draft-animals from vehicles or the like, and is designed to be capable of rapid and easy operation for the purpose of preventing accidents. An additional brake may be used and it can be applied to any vehicle. The handle when in normal position, will be a convenient rest for reins.

Prime Movers and Their Accessories.

GAS-COMPRESSOR.—C. FLOHR, Berlin, Germany. Mr. Flohr's invention relates to improvements described in United States Patent No. 669,140; and the objects are, first, to replace the single-acting pump referred to in the patent by a double-acting pump serving as a gas-compressor; second, to replace the means mentioned therein for locking and releasing the suction valve cone by one or two rocking return disk valves placed in a separate channel which connects the two cylinder ends of the double-acting pump, and third, to provide means for connecting the one or two rocking return disk valves with the float.

ROTARY MOTOR. M. M. CONGER, Linneus, Mo. This improved motor embodies a rotary piston provided with valves which are pressed outward by the steam and during a portion of their travel act against inclined surfaces on the case, giving turbine action, the outward thrust against the inclines serving by force of reaction to move the piston forward. Direct action of motive agent is utilized against the piston-valves, and when valves reach farthest projection beyond periphery of the body of piston steam is admitted to their outer faces to balance pressure and reduce to minimum the work to be done by motive agent in forcing the valves inward.

Railways and Their Accessories.

AUTOMATIC CAR DISCHARGE-VALVE.—W. A. HARRIS and R. S. H. HARRIS, Greenville, S. C. In this patent the invention is an improvement in automatic car discharge valves intended and adapted especially for use in train-signaling apparatus, and particularly in signaling apparatus wherein the signal is caused to sound by a slight reduction of pressure in the train-line.

SPARK-ARRESTER FOR LOCOMOTIVE OR OTHER BOILERS. J. C. REWRING, Sydney, New South Wales, Australia. This invention affords greater facilities for preventing escape of sparks and live cinders from locomotives and other chimneys and provides arrangements whereby the draft may be controlled to suit the requirements of any class of fuel or work, the apparatus occupying but a small portion of space in the smoke-box or "combustion-chamber" and easily removable for cleaning tubes, etc., and capable of adjustment so that the portion designated the "spark-cage" may be located to suit the needs of any boiler or class of fuel.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 5921.—For manufacturers of sand lime bricks.

AUTOS.—Duryea Power Co., Reading, Pa.

Inquiry No. 5922.—For manufacturers of solid celluloid for enameling purposes (to put on wood).

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 5923. For the address of the Fisher Hydraulic Press Co., for cement building blocks; also the address of "Normandin" hand tamp system.

For hoisting engines. J. S. Mundy, Newark, N. J.

Inquiry No. 5924.—Wanted, to purchase steam turbine outfits like those used on locomotives for head lighting purposes.

Any metal, sheet, band, rod, bar, wire; cut, bent, crimped, punched, stamped, shaped, embossed, lettered. Dies made. Metal Stamping Co., Niagara Falls, N. Y.

Inquiry No. 5925. For manufacturers of amateur printing presses.

Perforated Metals, Harrington & King Perforating Co., Chicago.

Inquiry No. 5926.—For manufacturers of armor bullet-proof cloth.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 5927.—For manufacturers of spirit from Indian corn.

If it is a paper tube we can supply it. Textile Tube Company, Fall River, Mass.

Inquiry No. 5928.—For firm handling a machine or apparatus to scrub and clean large floors.

WANTED.—Addresses of importers and consumers of bamboo. D, F. Mitchell, Jacksonville, Fla.

Inquiry No. 5929.—For parties who manufacture or handle machinery for separating the fiber and pulp of the Agava plant.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 5930.—For good, practical dry storage battery to take the place of ⅛ h. p. 120 volt motor, either direct or alternating current.

American inventions negotiated in Europe. Wenzel & Hamburger, Equitable Building, Berlin, Germany.

Inquiry No. 5931.—For some one handling experimental apparatus for wireless telegraph, such as is used for lecture purposes.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Machine Company Foot of East 138th Street, New York.

Inquiry No. 5932.—For an apparatus by means of which floors may be cleaned and varnished, instead of using manual labor.

Patented inventions of brass, bronze, composition or aluminum construction placed on market. Write to American Brass Foundry Co., Hyde Park, Mass.

Inquiry No. 5933.—For dealers in necktie makers' supplies.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 5934.—For parties who deal in album clasps and trimmings, and walking canes and umbrella mountings.

Two patents for sale. Supply tanks for water service, No. 195,662. Valve, a cut-off, for supply tanks, No 737,941. Can furnish some valves, cut-off, in working order. P. J. Lotthauser, Clarendon, Texas.

Inquiry No. 5935.—For manufacturers of gasoline buses, freight and delivery wagons.

English and European Market for American Manufactures.—W. & R. Leggott, Limited, East Parade, Bradford, England, is in remarkably good position for handling any article connected with building trade, and will be glad to act as agent for American firms. Please communicate.

Inquiry No. 5936. For manufacturers or sellers of farm ditchers.

Inquiry No. 5937.—For firms who manufacture or sell machinery for mining and preparing slate for the market.

Inquiry No. 5938. For firms manufacturing machinery for the extraction of cocoanut oil.

Inquiry No. 5939.—For parties manufacturing automatic pipe bending machines for bending long pipes as well as short return bends.

Inquiry No. 5940.—For a machine that will pulverize charcoal.

Inquiry No. 5941.—For manufacturers of wagon hubs, spokes and rims.

Inquiry No. 5942.—For the address of J. Baum Safe and Lock Co.

Inquiry No. 5943.—For manufacturers of woven wire fence.

Inquiry No. 5944.—For parties manufacturing rolling, sound-proof curtain or partition, such as are used in churches and Sunday-school rooms for dividing a large room.

Inquiry No. 5945.—For manufacturers of automatic ventilators and oil heaters.

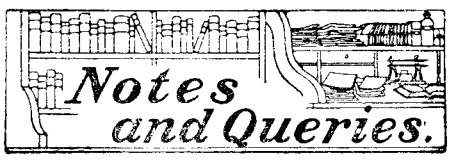
Inquiry No. 5946.—For machinery for making 2 x 4 x 8 inch concrete brick (sand and cement).

Inquiry No. 5947.—For manufacturers of corn huskers.

Inquiry No. 5948.—For address of agent or manufacturers of a contrivance for conveying rural mail from route to residence.

Inquiry No. 5949.—For manufacturers of carbonic anhydride refrigerating machinery.

Inquiry No. 5950. For manufacturers of machinery for hulling cocoanuts to extract the oil and work the fiber of same.



HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9447) W. J. M. asks: 1. Is it safe to run two double covered annunciator wires in the partitions of a house along with the gas pipes, for electric gas lighting? A. Electrical wires should not be run side by side in contact for any purpose. Insulation is liable to be impaired and current lost even if the current is not of a character to set fire. Especially is this true if the wires are held by staples. Two wires should never be put under the same staple. 2. Is there any danger of short-circuiting and thus setting fire to the house? A. Not with wires carrying current from a low voltage battery. If the current is that of a lighting circuit the rules of the Fire Underwriters forbid including two wires in the same fastening, and specify the distance by which they must be separated. 3. How large a coil would be required for lighting one burner at a time? A. A spark coil for gas lighting may be made by taking iron wires 10 inches long and forming them into a bundle 1 inch in diameter, first straightening them very carefully. Fit a spool head of hard wood on each end to hold the copper wire of the coil, and cover the iron core by two or three layers of brown paper to insulate the core from the coil. Two or three pounds of No. 16 or No. 14 cotton covered copper magnet wire may now be wound on the core. The ends of this should be brought out through holes in the head of the spool, and the coil is finished. A covering of pasteboard may be put over the outside as a protection and a finish. 4. What voltage and amperage would the same require and would two gravity cells answer the purpose? A. Three or four dry cells will be sufficient for gas lighting. Three LeClanché cells may be used if more convient. 5. Is a constant current required when you simply turn on the gas and it lights as with the Advance burners? A. A constant current battery is not used for gas lighting, but an open circuit cell is to be preferred. 6. What is the best way to connect coil, burner, and battery for the best results? A. The coil, burner, and battery are to be connected in series; it matters not about the order. The only important thing to be observed is to connect the cells of the battery in series, since as high a voltage as possibly should be had.

(9448) R. R. S. asks: 1. Are there any electric lamps that use an alternating current, and if so, how is it worked? A. The alternating current is now in more general use for lighting than is the direct current. The same incandescent lamp can be used on either current, if the required voltage is the same for both currents. The alternating current is, however, usually at 52 or 104 volts, while the direct current is ordinarily at 110 or thereabout. An arc lamp is especially constructed for the alternating current. Its two carbons consume at the same rate, while the carbons in a direct current arc lamp consume at different rates, the positive carbon wasting about twice as rapidly as the negative carbon. 2. Would there be any danger from lightning with a mast such as would be used in wireless telegraph experiments? A. There would be the same risk from lightning with a tall mast for wireless telegraphy as for any other purpose. Such a mast should be protected by a lightning rod. The apparatus should be and always is provided with lightning arresters.

(9449) A. J. G. says: 1. What commercial metal will radiate heat the most rapidly? A. Cast iron with a dark surface is the most radiant of heat of the simple metals. 2. Can an alloy be made that will be more efficient? A. There is no alloy known that is more efficient in radiating power than iron. 3. Is there any chemical composition that can be lowered in temperature by agitation? A. We know of no chemical compounds that become colder by agitation alone. Agitation that produces chemical changes may lower temperature. 4. How long will it continue to so do before it will be necessary to renew it? A. Time unknown. 5. Will it attack metals? If so, what metals? A. Not known. 6. Can you give me the formula for a hard copper plating bath same as used on leaded glass windows to strengthen them? A. Use a saturated solution of sulphate of copper and deposit by battery. 7. In order to muffle the exhaust of a gasoline engine what is necessary, to

(*Continued on page* 168.)

GEORGIA TILL BASKET AND PADUCAH FACTORY.

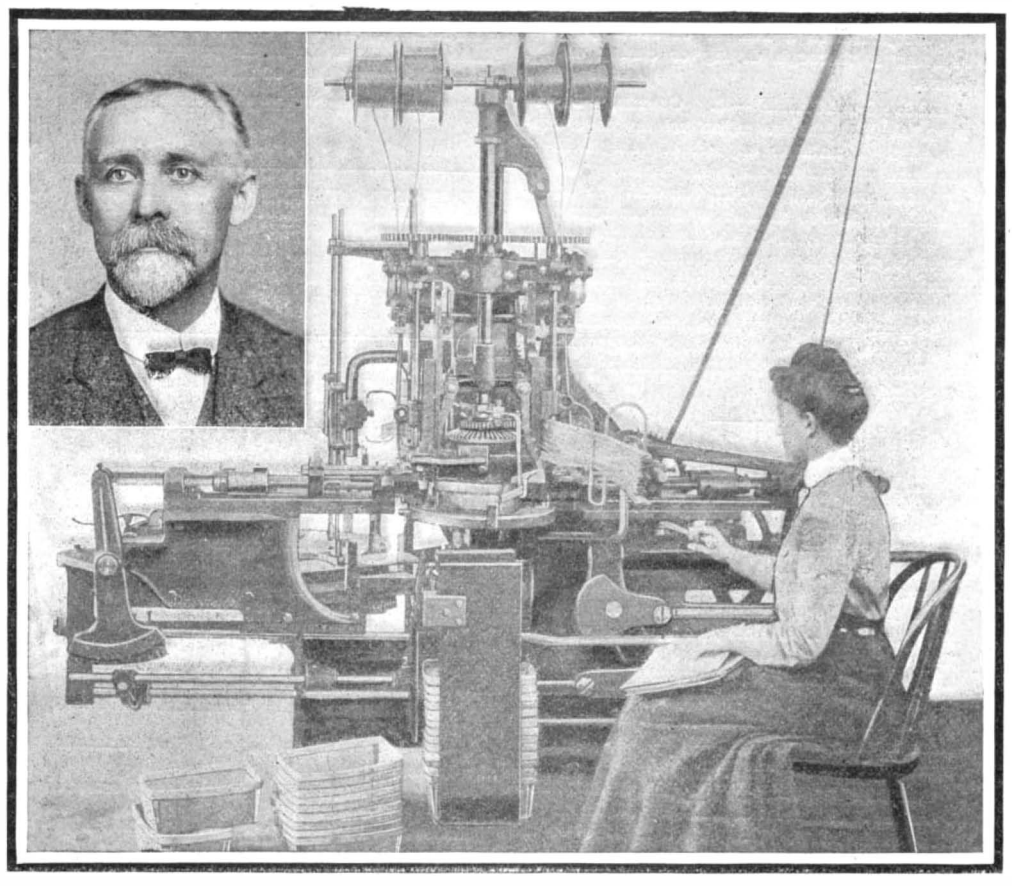
The achievement of Emmet Horton in making a machine which, working automatically, will construct from 18 to 22 peach baskets per minute, is not merely a remarkable thing in itself, but has a sweeping influence on the culture and marketing of fruits and vegetables, particularly through the South.

Probably no industry has in the past been more subject to vicissitudes than the growth of fruit. It has had to run the gauntlet of all kinds of weather and great variation in the prices to be obtained for the ripened product, while at the same time it has been at the mercy of wholly inadequate facilities for securing packages in which to deliver the product to the consumer.

During the season which has just closed it is roughly estimated that three hundred million quarts of strawberries rotted on the vines, because the grower could not procure baskets at any price to move them to market, and during this same season it is reported that in the State of Georgia fully enough peaches for ten million baskets never reached market for the same reason.

These conditions of inadequacy in the basket supply do not demonstrate that there are not enough people who will work for wages to make the necessary supply of baskets, but in view of the uncertainty of the volume of product to be shipped, and the necessarily low price at which the baskets must be supplied, a good fruit season finds the growers with only a small proportion of their supply of baskets contracted for, since they themselves cannot tell what the volume of their crop will be until close to the maturing of the fruit, with the result that there is a scramble for basket supplies during a good fruit season and none of the hand-working machinery is in a position to respond with sufficient rapidity to the sudden demand.

Nearly everybody now is familiar with the oblong baskets about 4 inches high and 7 inches wide in which the Georgia peaches are shipped to market. This basket has become the most freely recognized carrier for peaches and tomatoes from southern fields to all markets. The consumption of these baskets during twelve months is now several hundred millions. It is a class of basket which was little used up to six or seven years ago, so that the especial need for machinery to make this particular basket did not begin to manifest itself until about the year 1900. In

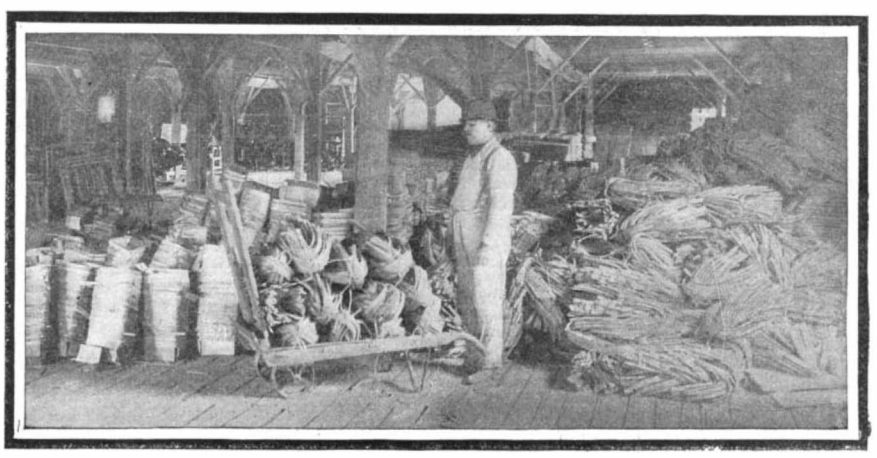


Emmet Horton and His Latest Fruit-Basket-Making Machine.

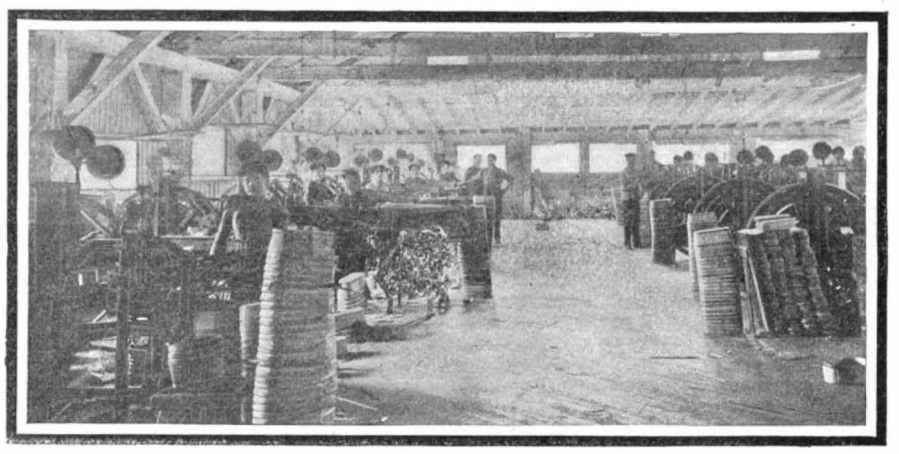
1902 Mr. Emmet Horton, who had made a life-work of inventing and constructing automatic basket-making machinery, particularly for the handling of grapes and berries, turned his genius toward the construction of a machine for the manufacture of these particular baskets, known as the Georgia oblong till. In the fall of 1902 Mr. Horton made his first till basket machine, constructing it along wholly different lines from any of his other machines, and in January, 1903, turned it over to the factory of the Mergenthaler-Horton Basket Machine Company for trial, and three months later, some slight changes having been made, construction was started upon a number of these machines. In the spring of this year ten machines of this class were put to work in the Mergenthaler-Horton Basket Machine Company's factory at Paducah, Ky., with the result of demonstrating, first, the capacity of the machine with one girl operator to deliver fully twelve times as many baskets per day as that same operator could make by hand; second, to manufacture these baskets out of a class of wood which heretofore had not been available by hand process, namely, out of gum lumber, thus lessening the cost of the material employed and benefiting the product by turning out a basket uniform in size and absolutely free from the objections which have been steadily experienced by fruit growers with the baskets made from the yellow or pitch pine tree.

The vital effect of the introduction of the till basket machine in the manufacture of baskets for Georgia peaches can be fairly well estimated when it is known that the year 1905 brings into bearing something like ten million new peach trees, within the limits of the State of Georgia alone. It is figured that at least twenty baskets of this size are required for an average yield of a peach tree, thus making estimates of an increase of demand for baskets of this class next year of two hundred million, and there is no one who is familiar with the facilities for making baskets throughout the southern country who does not know that these facilities cannot respond to this increase of demand, even if every existing factory started at once to make the supply required. It is only by the use of these machines that the fruit growers of Georgia next year will be able to secure the carriers in which to take their goods to market.

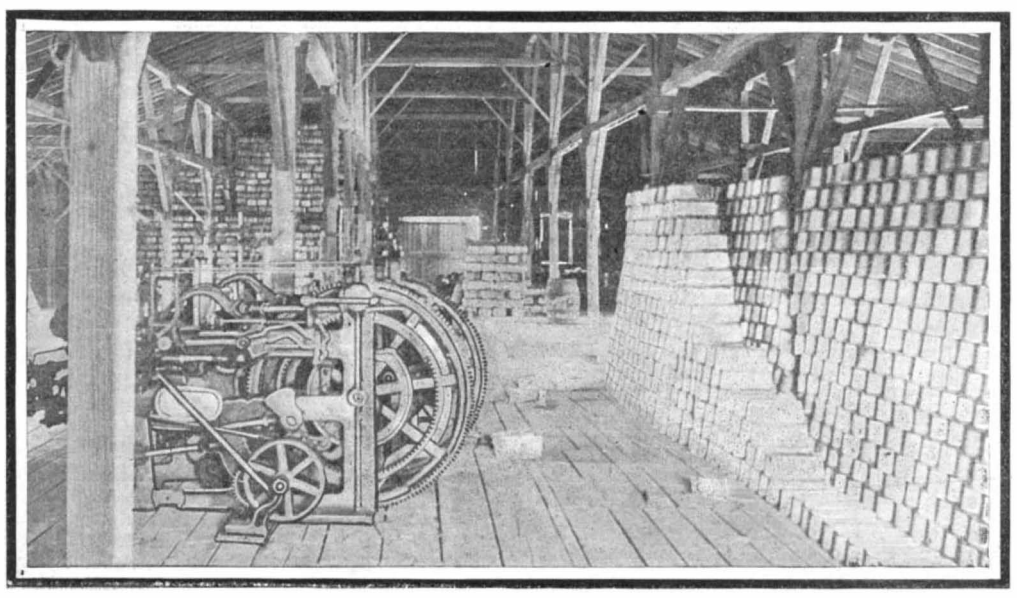
At the factory of the Mergenthaler-Horton Basket Machine Company at Paducah, Ky., situated on the banks of the Tennessee River where it flows into the Ohio, the supply of gum timber is floated down the Tennessee River. the logs hoisted up to the sawing machinery, cut into four-foot lengths and dropped into steaming vats where they remain over night. The next day the logs, averaging in diameter from 24 to 40 inches, are placed on a veneer machine, and the



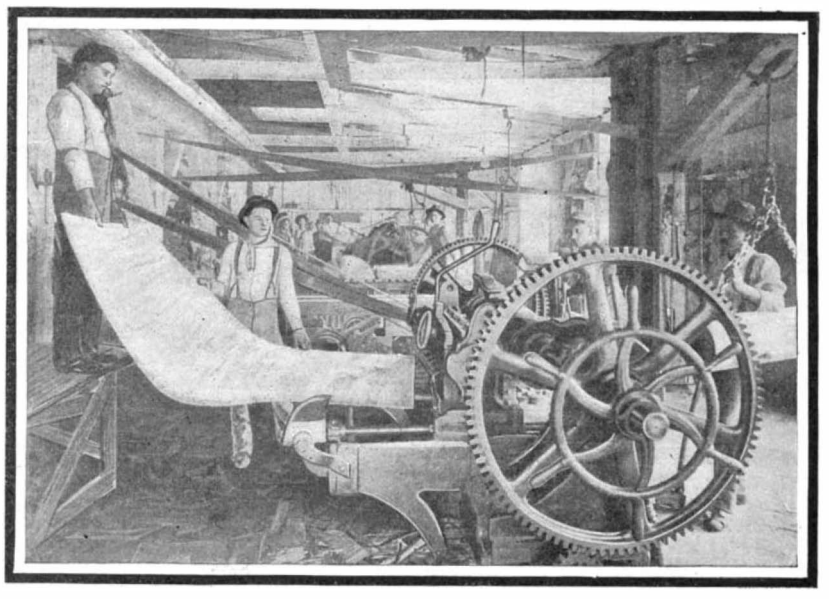
The First Floor of the Warehouse.



Twelve Grape Basket Machines at Work.



The Second Floor of the Warehouse where Goods are Stored.



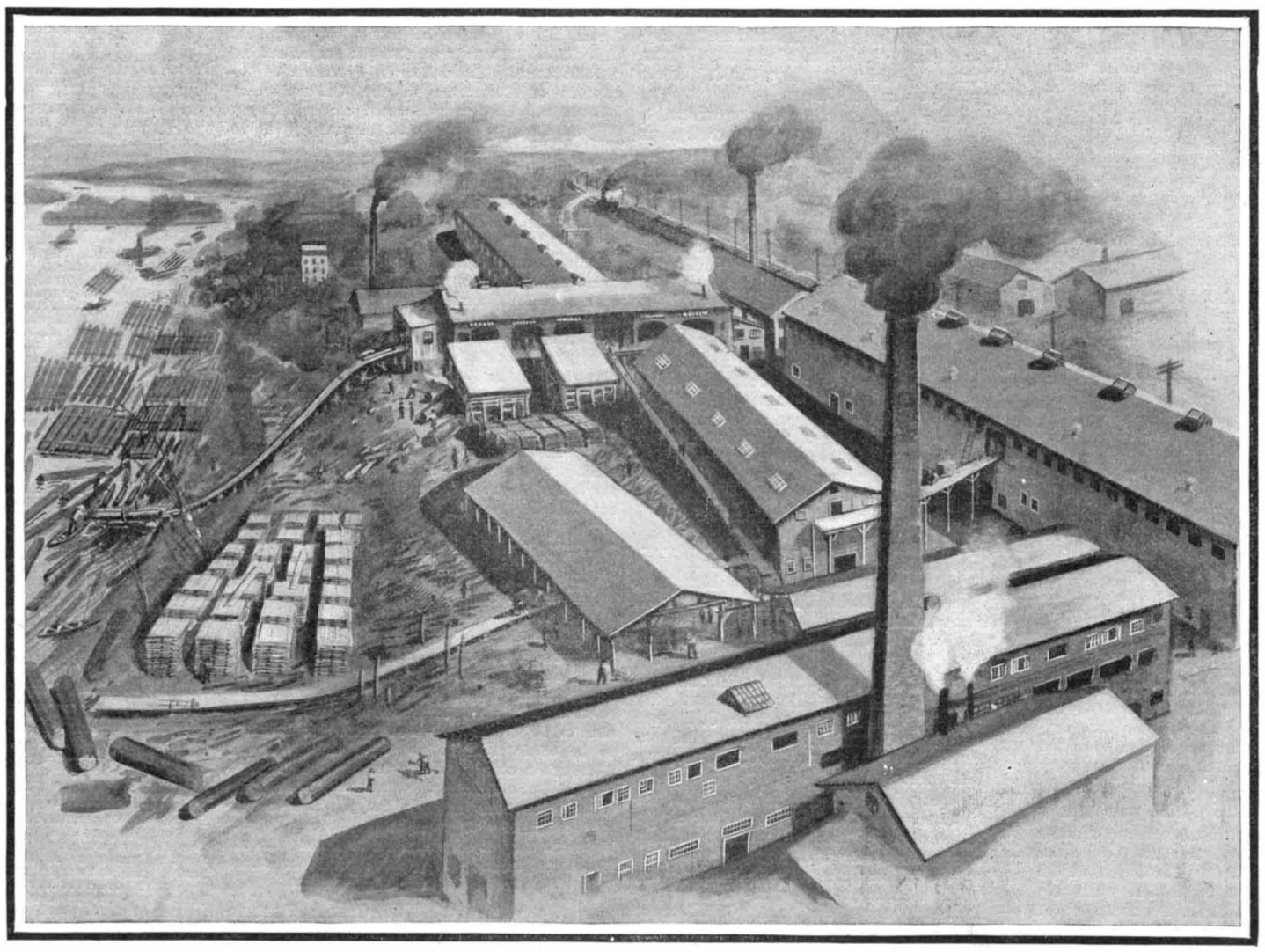
Two Large Veneer-Cutting Machines.

GEORGIA TILL BASKET AND PADUCAH FACTORY.

veneer is the same day worked up into baskets and the baskets are placed in the drying house to be shipped the following day. Thus the ordinary course of manufacture by machine is that the second day from the river the log has become baskets, and is on its way to the fruit grower.

Because of this rapid process, the gum timber can be utilized; with any slower process it would curl up and not work successfully. This fact has prevented the manufacturers who make baskets by hand from availing themselves of the inexhaustible supplies of this particular lumber, which is the cheapest lumber in the world. In contrast to it, for the special purpose of making fruit baskets, the yellow pine has many disadvantages. In the first place, the trees are much smaller, and the cost is about double. In the next place, there is a distinct odor which frequently injures the flavor of the fruit. In the third place, very frequently indeed the yellow pine baskets, when newly made and exposed to a hot southern sun, exude some of its resinous sap, which is of course very injurious to the fruit packed in the baskets. Many consumers of peaches and tomatoes will probably never know how much they have to thank the inventor of the automatic basket-making machine for this one accomplishment alone which enables them to get these products in baskets absolutely sweet and clean and free from all contamination.

The Mergenthaler-Horton Basket Machine Company is making every effort to multiply equipment of these machines to meet the growth of demand. It is planning the erection of one or two more factories on a large scale to house and operate machines as fast as they can be constructed, locating such factories within the reach of the supply of gum lumber, and as close as possible to the fields where the heaviest demand arises. Florida will need during the months of January, February, and March about 2,000 carloads of these baskets, Cuba during the same period about 500 carloads; Texas, and Arkansas follow with heavy demands, then comes Georgia. This article refers particularly to the important invention of the machine for making the Georgia till basket, and the other wonderful machines made by Mr. Horton for the manufacture of berry baskets and grape baskets can be touched upon only casually. The machines for making each of these different kinds of baskets are arranged on lines wholly independent of each other. Some of them have demonstrated new mechanical principles, and the Patent Office has allowed claims for new mechanical movements.



VIEW OF THE MERGENTHALER-HORTON BASKET MACHINE COMPANY'S PLANT AT THE INTERSECTION OF THE OHIO AND TENNESSEE RIVERS, PADUCAH, KY.

Mr. Horton's latest improved machine for making the quart strawberry basket is remarkable for many things about its construction, but its great commercial value is undoubtedly its power of delivering over 30 completed quart baskets per minute. The latest mechanism for this machine was planned to turn out nearly 40 baskets per minute, but at this speed it was found to be difficult to get the completed basket under all circumstances entirely cleared from the form before the wood for the succeeding basket entered the machinery. Consequently to make a machine for steady commercial use, it was found necessary to slightly reduce the speed so that to-day the final quart strawberry basket machine is being put together by Mr. Horton at the machine shop in Elmira registered to a speed of 32 completed baskets each minute, or nearly 2,000 per hour. The earlier quart berry basket machines have progressed from a speed of 12 baskets per minute up to a speed of 22 baskets per minute, which are the ones now in operation by the Mergenthaler-Horton Basket Machine Company people at their Paducah plant. These machines turn the four sides of the basket successively to the stapler, whereas the latest machine has staples on two sides, so that one turn of the basket completes the work. The company is expecting to have 20 of the latest machines turning out baskets in good season for next year's berries, to prevent, if possible, the tremendous loss the growers experienced this year, and incidentally to add largely to its revenues. One girl operator handles this machine.

The machine for making grape baskets was quite fully described in these columns two years ago, and needs no extended mention here. In practical operation in the factories its efficiency has been demonstrated. It is scheduled to make 4,200 baskets per day, and actually can be depended upon for about 3,600 baskets per day with the varying skill of the operator. These baskets are of a much more substantial character than the baskets for peaches and berries. They have to be made strong enough to travel independently without being crated in freight cars.

Mr. Horton has devoted a large part of his life to the inventions which are all controlled by the Mergenthaler-Horton Basket Machine Company. In laying out his till basket machine, the basis of his calculation is the number of feet which the belt must travel while one basket is being made, and before the next one is on the form. From this basis all of its movements are calculated, and are done with such nicety that the first till basket machine he made ran successfully the first day the belt was put on it. This is the more remarkable because this is the machine in which an absolutely new mechanical movement is used.

The same mechanism which is used in making the oblong till basket is to be applied to the manufacture of machines for making the square California fruit basket.

The following description may, therefore, be considered that of a typical machine: The body blanks for the basket are arranged in two piles in receptacles at one side of the machine, to which receptacles they are fed at intervals by automatic mechanism operated as soon as the supply of blanks in the receptacles is exhausted. A blank is lifted from each pile and deposited on a die, one blank being placed crosswise of the other, and when thus crossed the blanks are carried by the die into position under a form of the general shape of the interior of the basket. Two bands for each basket are fed to the form, and, by a partial rotation of the form, are wrapped around it. After this the die is raised, causing the body-blanks which it carries to be bent around the form and to inclose those portions of the bands wrapped around the form. At this time the body-blanks are secured to each other by a staple driven centrally through the bottom of the blanks. The form is then further rotated in such manner as to cause the bands to be wrapped around the outside of the body-blanks at their upper edges, and then these bands are secured to each other and to the body-blanks by staples made from wire, just before they are driven, the nailing mechanism being so operated as to give a relatively long stroke when attaching the bands to the long sides of the oblong basket and a relatively short stroke when attaching the bands to the ends of the basket. After the blanks have been bent around the form by the die and the bands have been attached, the die is lowered and carried away to one side to receive a new set of body-blanks. As soon as the bands are nailed to the body-blanks the basket is complete, and the form is lowered to deposit the completed basket in a chute, the basket being stripped from the form by hooks carried by the upper end of the chute. The completed baskets are stacked in the chute one above the other, and when a predetermined number has been reached, the pile of baskets is automatically removed from the chute and deposited upon a trough, from which they may be removed by hand or automatically.

The form carries band-receiving hooks with which co-operate spring-pressed dogs that serve to hold the bands in the hooks. The hooks are mounted to turn about horizontal axes, whereby they may be at one time held up to receive the bands and at another time turned to permit the discharge of a completed basket. Gearing is provided which is automatically actuated to move the hooks at the proper time. Plungers insert the bands into the hooks and engage a completed basket and eject it from the form after the band-receiving hooks have been reversed or turned downward. These plungers, it should be mentioned, are made to swing on horizontal axes, so that after they have completed their downward movement and commenced to move upward they swing inward, so as to clear the bands which have been made to engage with the form and also the bands which are being fed by the band-feeding screws. This swinging movement of the plungers is obtained by means of rods which are made to pass vertically through friction devices and which are pivotally connected with the plungers at points to one side of their pivots.

How soon the company which controls all of these patents and machinery will be able to enter the California field is not known. It would seem that an equipment sufficient to take care of the growth of demand for all classes of fruit baskets east of the Rocky Mountains would consume all of the energy of the big organization for two or three years. But these are the days of achievement, and it may be that the California field will get the benefit of Mr. Horton's genius before two years more. The foreign patents on the machines invented by Mr. Horton are owned by the Emmet Machine Company and cover nearly every country on two continents where timber is grown of sufficient size and character to make this class of baskets.

The inventions in basket-making machinery made by Emmet Horton, and before he died, by Ottmar Mergenthaler, of linotype fame, constitute an unusually perfect safeguard against competition for the company which owns them, because no other inventors have ever been able to make a basket machine successfully, and Mr. Horton's inventions now have so fully covered the entire field that the company may well feel protected in every way by the possession of these patents on these great inventions.

baffle it, stagger it, or what, to accomplish the best results without back pressure? A. Any form of exhaust chamber in which the force of the exhaust is divided and gradually expanded will deaden the sound. 8. What is the scientific reason for the noise at the end of an exhaust pipe of a gasoline engine? A. The noise of an exhaust is caused by its impact against the outer air. 9. Is there anything gained in radiating surface by having projecting ribs on gasoline engine cylinders? A. Anything that expands the air surface contact with the cylinder is a gain to air-cooled cylinders. The ribs accomplish the desired extension of air-cooling surface.

(9450) W. A. K. asks: What books for instruction would you recommend to one who understands only the rudiments of electrical science and wishes to perfect himself in the art? A. The books required for the study of electricity depend entirely upon how you would study. If you would become an educated electrical engineer go to Columbia University and take the course. If that is impossible, you may be able to take a correspondence course at some of the correspondence schools. (The International Schools, at Scranton, Penn., are very large and can furnish you a good opportunity if you are determined to do good work.) It is hardly possible by study by oneself to become an electrician. Contact with machinery, instruments, and men doing the actual work are necessary. There is so much which is not in any book which must be known. You say you wish to "perfect yourself in the art." If that has its usual meaning that you wish simply to learn how to do electrical work, the best way to learn that is to obtain a position in an electrical shop and learn the art of making the apparatus; or in a construction company and learn the art of installing machinery, the line, etc.; or in a station and learn how to operate it. There are many lines of learning from which you must choose one, according to your means, and possibilities, of which you do not give us any intimations. Lastly, if what you wish to learn is electrical science, you can then begin with books and study either with or without a teacher, though far better with a teacher. You might start with "Swope's Elementary Lessons," price $2.00; go on into "Hawkins and Wallis' Dynamo," price $3.00; take next "Thompson's Dynamo Electric Machinery," price $7.50, and his other books; follow with "Crocker's Electric Lighting," 2 vols., price $6.00; after this might come the transmission of power, electric railways, etc. There are books enough to last for many years of study for the man studiously inclined.

(9451) C. H. McC. says: Can you tell me where I can find a description of the apparatus used by Telsa to generate the high tension currents with which he was experimenting a few years ago? I believe he called his machine an "oscillator." If there are any SUPPLEMENTS describing these experiments please let me know the numbers. A. We have published a description of the high frequency coil in our SUPPLEMENT No. 1087, which are will send for ten cents. The United States Electrical Supply Company, Mt. Vernon, N. Y., make the apparatus, both for generating the electricity and for the experiments, thus furnishing a complete outfit which can be relied upon to do the work. These outfits are very highly spoken of.

(9452) O. H. says: Will you kindly inform me what is the best protection against lightning for telephones, viz.: to protect the ringer, coil, and building? Would you advise "dead ends" or ground connection when the 'phone is disconnected from the main wire? Is the lightning arrester now in use absolute protection? A. Lightning arresters, which will be furnished by the telephone company, are the best protection for telephones from lightning. There can be no such thing as "absolute protection" from lightning. Reasonable protection is all that can be had. The usual lightning arrester works through a grounded wire to the earth. We know of nothing better. Comparatively few instruments are now burned out by lightning.

(9453) H. M. says: You will very greatly oblige me by kindly answering the following questions concerning "The Tesla Thomson High Frequency Coil" as described in SCIENTIFIC AMERICAN SUPPLEMENT No. 1087. 1. Should wire known as magnet wire be used on the primary? on the secondary? A. It is better to use covered or magnet wire as it is commonly called, in winding all induction coils, even when insulated with oil. 2. What kind of insulation should the secondary of the high tension trans. have? Will single cotton covered do? A. High frequency coils are ordinarily insulated with oil. Double cotton covered wire is to be preferred to single covered wire when large differences of potential are to be produced. 3. How many pounds of wire are required for each coil of wire on the high tension transformers? How many pounds will be required for the secondary of the high frequency coil? A. We have not the weight of wire at hand for the coils you intend to make. It is more common to specify the number of turns of wire. You can transform turns to pounds approximately by calculating the length of one turn in the middle layers of the coil and multiplying by the total number of turns. A table for copper wire will give you the number of feet per pound for any size of wire. 4. Will the increase in length of spark warrant an oil insulation? A. It is not probable that the coil will stand the strain except by oil insulation. Even then the insulation may be punctured frequently, but as soon as the oil closes in again the insulation is restored.

NEW BOOKS, ETC.

THE PLANETARY SYSTEM. A Study of Its Structure and Growth. By Frank Bursley Taylor. Fort Wayne, Indiana: Frank Bursley Taylor; London: C. D. Cazenove & Son, 1903. 12mo.; pp. 278; illustrated. Price $1.50.

Our author first challenges Newton's theory of the moon's stability, on the ground that, if correct, it should serve as a basis for generalization, and should yield a law for the stability of inner satellites. This it has failed to do. The author then advances a new theory of stability which, he claims, does yield such a general law. The application of this theory accounts for the origin of the asteroids, the separation of the planets into two groups with the asteroids between, the position of the superior planets next outside of the asteroids, the greater masses of the superior planets, and the origin of Saturn's rings. The new hypothesis also leads to interesting explanations of various other facts and phenomena, such as the retrograde satellite systems of Uranus and Neptune, the inclination of the moon's plane to the earth's equator, etc.

SYSTEMATIC POMOLOGY. By F. A. Waugh, Professor of Horticulture and Landscape Gardening, Massachusetts Agricultural College. New York: Orange Judd Company, 1903. 8vo.; pp. 300. Price, $1.

The study and classification of fruits is necessary in order to make possible their most prolific development. Prof. Waugh, in his new book on this subject, gives instructions for the systematic study and classification of our various fruits, which will be of value to fruit growers, teachers, and all scientific investigators of this subject. The book treats exhaustively of the methods of describing fruits, of the perplexing system of nomenclature, of the practical and scientific classification of varieties, and of the judging and scientific laboratory study of all kinds of fruits. The book will be found particularly helpful to students who wish to learn more about pomology from practical self-investigation. It will also be of great service to nurserymen and fruit growers, as well as of use as a laboratory guide and manual. Complete instructions regarding the photography of fruits and the keeping of card catalogues of the same are among the valuable features of the book.

DAMPFSCHNELLBAHNZUG für 120 km. mittlere stündliche Geschwindigkeit (150 Km.-St. maximal). Von Dr. Ing. Heinrich Mehlis. Mit 10 Tafeln in Photolithographie. Zweite Auflage. Berlin: Verlag von Georg Siemens, 1904.

NOTES ON ELECTRIC RAILWAY ECONOMICS AND PRELIMINARY ENGINEERING. By W. C. Gotshall, M. Am. Soc. C. E. and Am. Inst. E. E. New York: McGraw Publishing Company, 1903. 8vo.; pp. 252. Price, $2.

This book is the outcome of a series of lectures which were given by the author at Lehigh University. It treats exclusively of high-speed interurban railways, taking up the subject at the preliminary office investigation of the probable earnings and expenses, and carrying it through track location and construction up to the completion and operation of the road. Detailed statements of costs of operation and their computation for different schedules are given, and the economics of such projects is thoroughly discussed. Full data regarding train resistance are given.

MACHINE DESIGN. By William Ledyard Cathcart, Adjunct Professor of Mechanical Engineering, Columbia University. New York: D. Van Nostrand Company, 1903. 8vo.; pp. 285. Price $3.

This book, which forms Part I. of the complete work, is devoted entirely to all kinds of fastenings used in machinery. The book is practical in treatment, but the theoretical side of the subject is also fully given for completeness' sake only, since this side of the subject has already been exhaustively covered by able writers. Both scientific analysis and the records of practice are essential to success in the design of machine members; but neither alone is trustworthy, as the former predicts only those stresses which prevail under normal conditions and ignores the overload, the rough handling, or the slight accidents which the machine may meet, and when meeting which, it should not fail. Practical data show only the proportions which constructors have given in specific cases of stress and service, and empirical formulæ founded upon them may not give the desired results, if the inherent limitations of these formulæ be exceeded. The problem of design is one whose many elements vary continually in number, character, and magnitude; and, for its solution, theoretical analysis, precedent, and the ripened judgment of the designer are required. The work has been prepared with the cooperation of many prominent engineers. Its chapters treat of shrinkage and pressure joints, screw fastenings, riveted joints, and keyed and pin joints. All formulæ and figures necessary for an adequate treatment of the subject, as well as a considerable number of illustrations, diagrams, and tables, add to the value of the book as a work of reference for practical engineers.

METALLURGICAL ANALYSIS AND ASSAYING. By W. A. Macleod, B.A., B.Sc., and Charles Walker, F.C.S. London: Charles Griffin & Co., Ltd.; Philadelphia: J. P. Lippincott Company, 1903. 8vo.; pp. 318. Price, $4.

The present volume is intended to meet the requirements of Anglo-Colonial schools of mines; and while we always feel a book which is intended as a textbook for specified courses is hampered, still the present volume appears to be an excellent one. Typographically the work is perfect, and the diagrams are very clear. It is a book which we can recommend to those who wish to study chemistry by themselves.

RAILWAY LEGISLATION IN THE UNITED STATES. By Balthasar Henry Meye, Ph.D. New York: The Macmillan Company, 1903. 16mo.; pp. 329. Price, $1.25.

The aim of this volume is to present a condensed analysis of the private and public laws which govern railways in the United States, and of important decisions relating to interstate commerce. The statements and comments are based upon actual analysis, and, in a large part, upon analytical tables of charters and laws enacted in the various States. These tables present so many typographical difficulties, it was not thought expedient to publish them. The author is Professor of Institutes of Commerce in the University of Wisconsin. He has performed an exceedingly difficult task, and the book should appeal to all thinking persons.

CASSELL'S POPULAR SCIENCE. Vol. II. Edited by Alexander S. Galt. Illustrated. New York: 1904. Square 8vo.; pp. 556. Price, $5.

This second volume of Cassell's Popular Science is characterized by the same treatment which we had occasion to note in our review of the first volume. For the most part the subjects are confined to pure science, the reviews of applied science being confined to electricity, photography, and the rifle. The articles are all of them written with a true regard for scientific accuracy, and are yet couched in such simple language that the man who makes no pretensions to scientific knowledge can readily understand them. Their length, moreover, has been so calculated that they will not fatigue the attention.

RADIUM AND RADIO-ACTIVE ELEMENTS. A Popular Account Treated Experimentally. By Leonard A. Levy and Herbert G. Willis. Illustrated. London: Percival Marshall & Co., 1904. 12mo.; pp. 105. Price, 25 cents.

Messrs. Levy and Willis have in this book endeavored to give a popular and withal a scientifically accurate account of radium. The book may be said to accomplish its purpose, and to do credit to its authors. It is likely to be of interest to the man in the street. Although a compilation in its way of the writings of Curie, Ramsay, Rutherford, Elster, and Geitel, the book nevertheless presents a certain originality of treatment. In our opinion the work may be commended to those who are interested in something more than the sensational side of radio-active substances.

THE WIDOW'S MITE AND OTHER PSYCHOLOGICAL PHENOMENA. By Dr. I. K. Funk. New York and London: Funk & Wagnalls Company, 1904. 12mo.; pp. 538. Price, $2.

If anyone expects to find in Dr. Funk's book a scientific exposition of spiritualism, or, indeed, anything at all that has not hitherto been known about spiritualism, he will be sadly disappointed. What Dr. Funk has done is to present an impartial account of certain spiritualistic experiences of his, which involved the finding of the Jewish coin, called the "widow's mite," through the spirit of Henry Ward Beecher. Dr. Funk's disclosures are no more remarkable than those of hundreds of other investigators, among them men of the standing of Sir William Crookes, Alfred Russell Wallace, Prof. Hyslop and Prof. James. Dr. Funk himself makes no attempt scientifically to explain the things that he saw or claims to have seen, contenting himself simply with a mere statement of facts, from which the reader is left to draw his own conclusions. Besides narrating the story of the "widow's mite," Dr. Funk presents an interesting account of the work of other men. Whatever may be one's opinion of the value of Dr. Funk's inquiry, one cannot but be impressed by his earnestness and his fairness.

TASCHENBUCH DER KRIEGSFLOTTEN. V. Jahrgang, 1904. Mit teilweiser Benutzung amtlichen Materials. Herausgegeben von B Weyer, Kapitänleutnant a. D. München: J. F. Lehmann's Verlag 1904. Pp. 341.

Capt. Weyer's new handbook contains pretty much the same information as last year's volume. We have had occasion to use his reference books more or less frequently ever since their publication, and have found them in every respect trustworthy and accurate. Indeed, in some ways his little volumes contain information not elsewhere to be found. Notably is this true of the general data pertaining to Russia's Baltic fleet, now in course of construction, to be found in last year's book. The events of the present war have naturally affected Russia's naval position to a marked degree. Capt. Weyer has still listed even those vessels of the Russian navy which have been destroyed; but has clearly indicated their loss, in order that no reader may be misled. It has been impossible to note similar losses in the Japanese navy, because no official reports can be obtained of the damage sustained.

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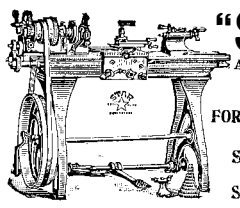

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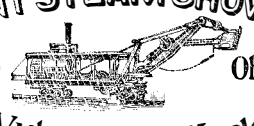

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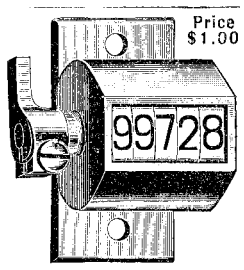

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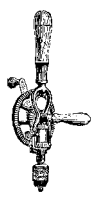

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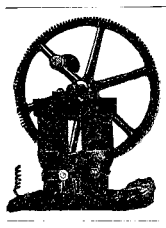

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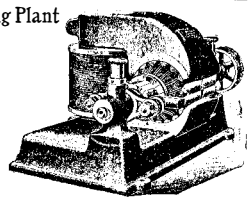

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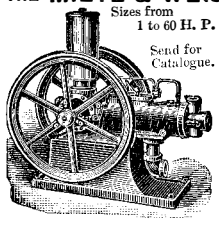

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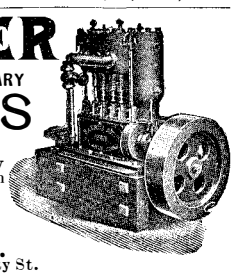

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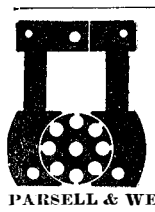

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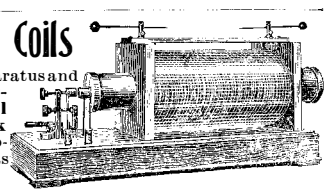

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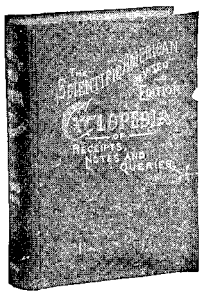

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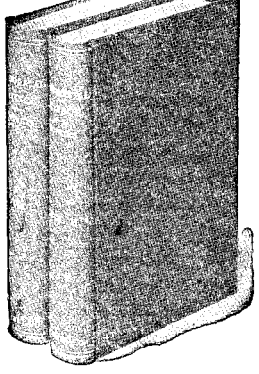

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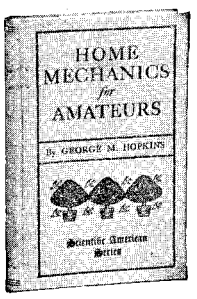

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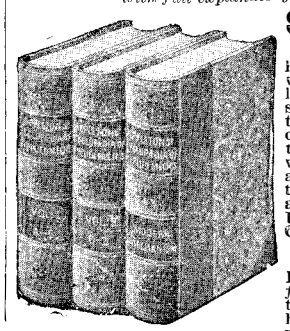

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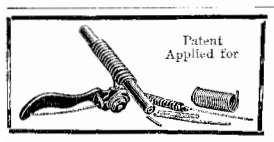

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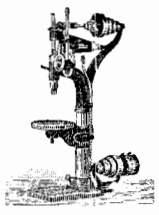

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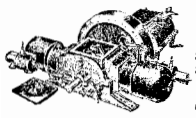

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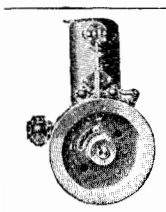

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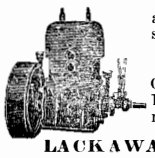

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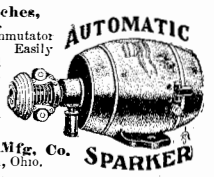

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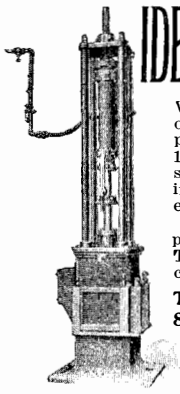

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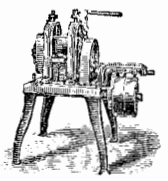

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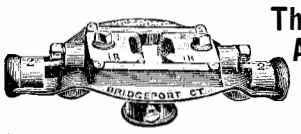

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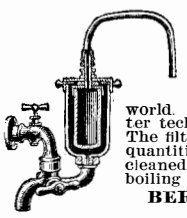

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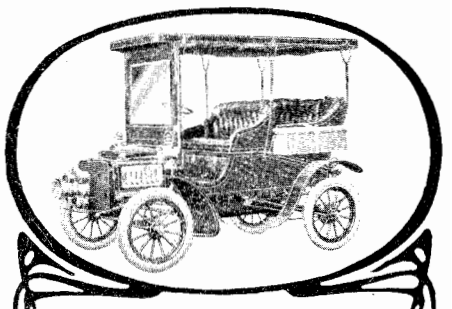

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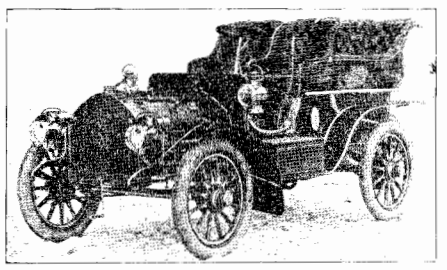

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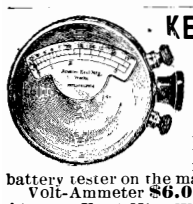

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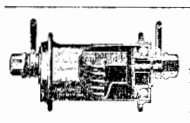

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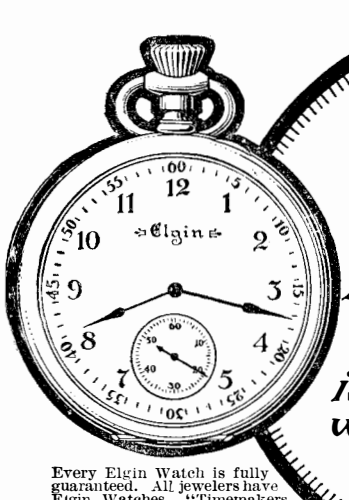

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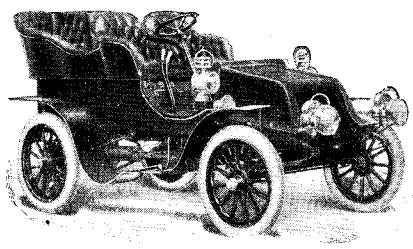

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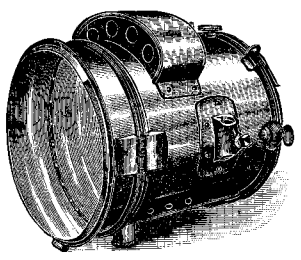

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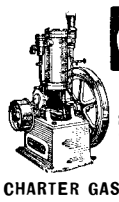

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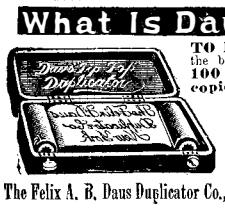

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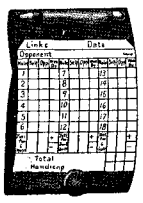

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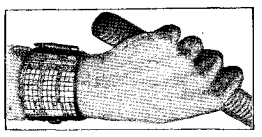

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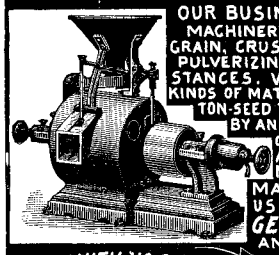

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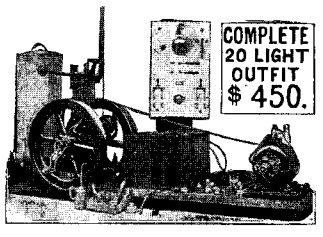

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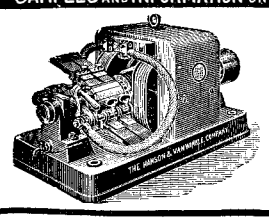

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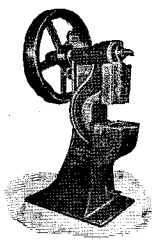

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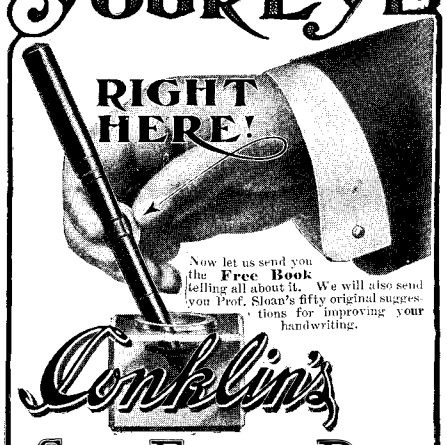

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